

# T E R R A

MAGAZINE OF THE  
NATURAL HISTORY MUSEUM  
OF LOS ANGELES COUNTY

VOLUME 30, NUMBER 3  
SPRING 1992





# ALLAN HOUSER



*"Lament", Bronze edition of 8, 66" x 15" x 27", ©1990 Allan Houser*

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COVER: "Thinking of Him," sculpture by Allan Houser. Alabaster, 19 by 13 by 18 inches. © 1980.

# TERRA

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# Museum on the Move

## NEWS

### ■ PETERSEN MUSEUM BUILDING FUNDED

Robert E. Petersen, chairman of the board of Petersen Publishing Company, has provided the lead gift of \$15 million toward the creation of a new history museum in Los Angeles. The new museum, which is to be operated as a satellite of the Natural History Museum of Los Angeles County, will be established in the building at the corner of Wilshire Boulevard and Fairfax Avenue that formerly housed the Ohrbach's retail store. Current plans call for a September 1993 opening.

The exhibitions at the Petersen Museum will focus on the Age of the Automobile and will involve cars and everything related to them. Through permanent and changing exhibitions and other programming, the new museum will explore the ways in which the automobile has shaped the twentieth century; the impact of the auto-

mobile on industry, commerce, advertising, labor, government, design, and technology; and the relationship between the automobile and American values such as freedom, independence, individuality, and power. The building will also provide meeting and reception facilities, a conservation lab, a state-of-the-art collections center, offices, and an indoor parking structure.

The son of an auto mechanic, Robert Petersen has both a professional and personal interest in automobiles. He began his publishing empire by founding *Hot Rod* magazine in 1948 with a \$200 investment. His company is now the largest magazine publishing firm on the West Coast. In addition to the still-successful *Hot Rod*, Petersen publications include *Motor Trend*, *Car Craft*, and *Motorcyclist*. In 1976, Petersen was awarded a distinguished service citation from the Automotive Hall of Fame in Midland, Michigan. He has served on the Natural History Museum Foundation's Board of Trustees since 1987.

Petersen's donation will help finance the purchase and renovation of the four-story museum building. The Los Angeles County Board of Supervisors has facilitated the establishment of the Petersen Museum by making excellent long-term bond financing available to the Natural History Museum Foundation for its purchase of the building.

### ■ MUSEUM DIRECTOR APPOINTED TO BUSH'S ENVIRONMENTAL COMMITTEE

Craig C. Black, director of the Natural History Museum, is among nine individuals named by President George Bush to serve on the new Environment for the Americas Board. The committee was formed to resolve economic problems in Latin America through debt-for-nature swaps, promotion of private investment, and extensive trade liberalization. The President's three-pronged approach is intended to reduce Latin American debt while encouraging environmental conservation.

Dr. Black was named director of the museum in 1982, and in 1986 was appointed by former President Reagan to serve on the National Science Board, where he chaired a committee studying the loss of biodiversity around the world. The museum's scientific research includes work dealing with environmental problems in Mexico, Costa Rica, Bolivia, Peru, and Brazil. Black's own research in geology and paleontology has taken him to Mexico, Ecuador, and Argentina.

The eight others appointed to the new board include Nicholas F. Brady, Secretary of the Treasury; James Addison Baker III, Secretary of State; William Kane Reilly, Administrator of the Environmental Protection Agency; Ronald William Roskens, Administrator of the Agency for International Development; Bill K. Perrin, Director of the Inter-American Foundation; James T. Morris, President, Chairman, and Chief Execu-

This prototype gas turbine engine car, created by the Chrysler Corporation, was one of 50 tested during the 1950s. All but seven of the prototypes were dismantled; this one, donated to the Natural History Museum in 1965, is the only example in the West of Chrysler's unique engineering endeavor. The car will be displayed in the new Petersen museum.



Courtesy of the Chrysler Corporation





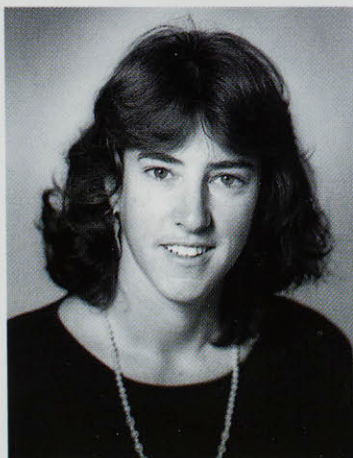
tive Officer of IWC Resources Corporation; Diane W. Wood, Vice President for Latin America and Caribbean Programs, World Wildlife Fund; and John C. Sawhill, President and Chief Executive Officer of The Nature Conservancy.

## STAFF

■ **ANTHROPOLOGY APPOINTS NEW CURATORS** Dr. Karen Wise and Dr. Christopher B. Steiner have joined the Natural History Museum as Assistant Curators of Anthropology.

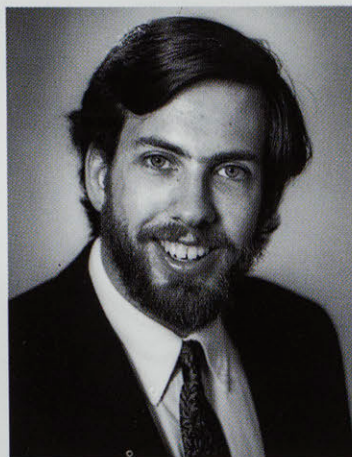
Dr. Wise is responsible for the museum's archaeology collections, which focus on the Americas. She has conducted archaeological field research in both North and South America, including the south-

western and midwestern U.S., as well as in Peru and Bolivia. Her research interests include human adaptations to coastal environments and the analysis of prehistoric economic systems, and her current field project focuses on 5,000-year-old specialized fishing communities on the



west coast of South America.

Dr. Wise received her Bachelor of Arts in anthropology from Wesleyan University, and her Master of Arts and Ph.D. in anthropology from Northwestern University.



Dr. Steiner is responsible for the museum's collections of African and Oceanic ethnographic artifacts. His field research has been conducted in Côte d'Ivoire, West Africa, on the history and social organization of the African art trade. He recently completed a one-year appointment as Kalbfleisch Postdoctoral Fellow at the American Museum of Natural History in New York City, and has published on a range of subjects, including a comparative study of body ornamentation in Africa and Polynesia. Dr. Steiner earned his Bachelor of Arts and Master of Arts degrees in humanistic studies at the Johns Hopkins University, and his Master of Arts and doctorate in anthropology at Harvard University.

## GRANTS

■ **NSF SUPPORTS MALACOLOGY COLLECTION** Dr. James H. McLean, Curator of Mollusks, has received a grant of \$192,597 from the National Science Foundation in support of the museum's mollusk collection, the largest of its kind in the western United States.

This is the third consecutive collection support grant provided by the NSF in recognition of the importance of the museum's collection as an international resource, studied by investigators around the world. The collection is particularly strong in species from the eastern Pacific, occurring from Alaska to Chile. The project commences in November 1991 and will be carried out by Curator McLean, Collections Manager Cliff Coney, and two NSF-funded staff members.

## ■ CHENEY CONTRIBUTION SUPPORTS MAMMALOGY SECTION

Through a generous contribution from Mrs. Maire Cheney, the William J. Cheney, Jr. Memorial Fund has been established to support the activities of the Section of Mammalogy. This endowment will be used primarily for the growth and maintenance of the mammal research collection. The research collection of mammals is one of the largest in North America and is particularly strong in bats, marine mammals, and North American rodents.

William J. Cheney, Jr. had a longtime interest in the Natural History Museum and the Section of Mammalogy. He sponsored several expeditions to East Africa, which resulted in installation of many fine dioramas in the museum. Dr. Kenneth Stager, Curator Emeritus and longtime friend of Mr. and Mrs. Cheney, assisted in making this endowment a reality.

## DEVELOPMENT

■ **CONSTRUCTION OF TIMES-MIRROR HALL OF NATIVE AMERICAN CULTURES COMPLETE** General construction for the handsome new Hall of Native American Cultures was completed in November. Dr. Margaret Hardin, the anthropology

(continued on page 48)



# "This Dignity, This Goodness That is in Man"

by William Clark

*"Human dignity is very important to me. I feel that way toward all people; not just Indians. In my work, this is what I strive for — this dignity, this goodness that is in man. I hope I am getting it across."*

— Allan Houser

ALLAN HOUSER LOVES THE blues. He's especially fond of the earthy, Mississippi Delta-inspired work of the late Muddy Waters, and it makes exquisite sense that such bedrock American music should strike a chord with one of this country's most prominent Native American artists.

Both the blues and Houser's sculptures evoke American archetypes; both employ classic, elemental structures that, far from limiting expression, allow ultimate improvisational freedom within their stylized bounds. And, like the blues, Houser's work sings the strength and dignity of a proud people with a hard history.

Houser is a Chiricahua Apache, a member of a tribe whose long and bitter struggle to defend its homeland in what is now southwestern New Mexico, southeastern Arizona, and northern Mexico against successive waves of Spanish, Mexican, and American settlers has achieved mythic status. Houser's great-grandfather was the renowned chief Mangas Coloradas. His father, Sam Haozous, was a teenager during the last years of Chiricahua freedom; he had begun his training as a warrior in Geronimo's band when the legendary leader surrendered to the U.S. Army in 1886, ending the Indian wars of the American West. Sam Haozous became Geronimo's friend as well as his translator during the 27 years the Chiricahuas were prisoners of war, first in Florida and eventually at Fort Sill, Oklahoma.

The U.S. government gave the Chiricahuas their freedom in 1913; Houser was born the following year, on June 30, 1914. He grew up on his family's farm near Apache, Oklahoma, not far from Fort Sill. There young Houser learned the values and ways and history of his people from the Apache songs his parents sang and from his father's stories about the old days of nomadic freedom. And there he began to draw, first horses, motorcycles, and cars to please his schoolmates; later, to please himself, he set out to render Indian subjects, to tap the Chiricahua heritage that has remained the wellspring of his art for over half a century. That

long and fruitful career — from his early paintings through his most recent sculptures — is celebrated in "Allan Houser: A Life in Art," the current major exhibition of his work at the Natural History Museum of Los Angeles County.

"I had all these stories," Houser says of his beginnings, "and I'd draw things and show them to my dad, and he'd correct any details that I'd gotten wrong. So I started out doing that, and it was very exciting."

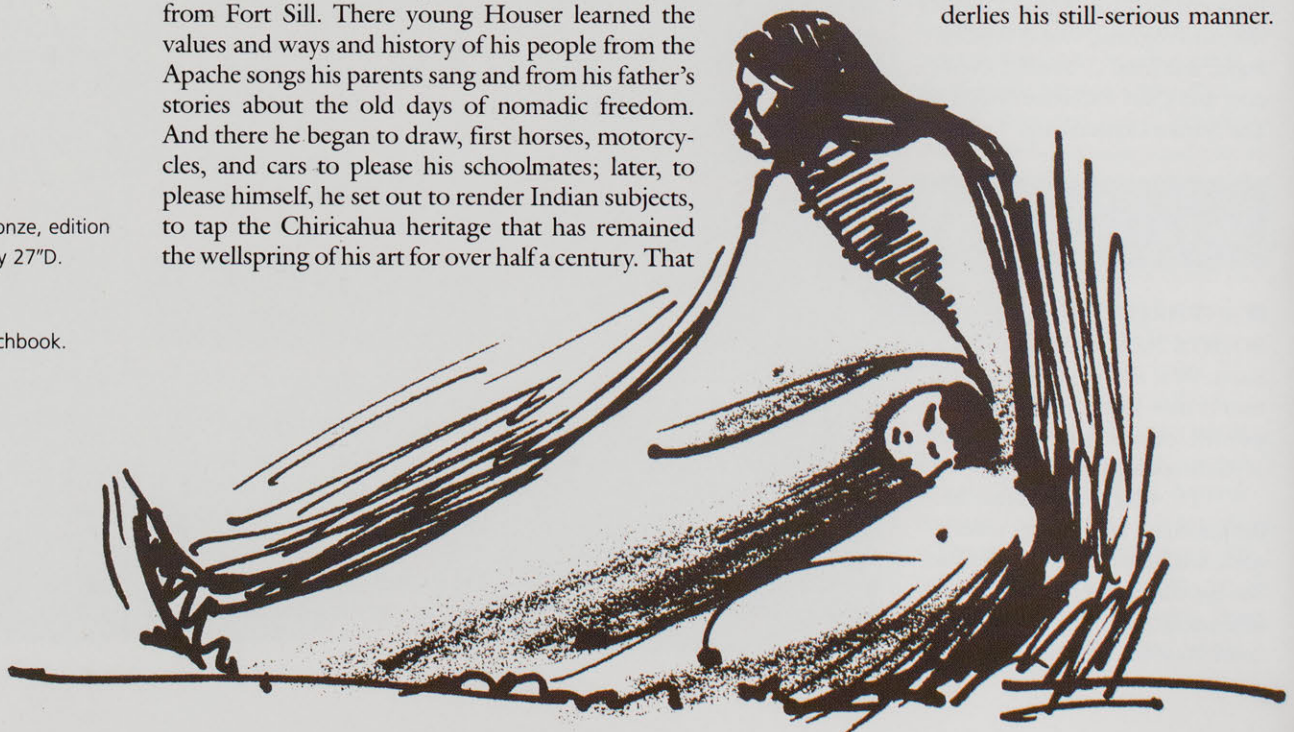
That excitement grew as he honed his drawing skills during the hard economic times of the Depression, balancing his artistic labor of love with the work of running the family farm.

"I was very anxious to get art experience of some kind," Houser says, "but we didn't have money for things like that. So when I saw a notice that the Santa Fe Indian School [which was free to Indians] was looking for students, I thought, 'That's my chance!'" Houser studied art from 1934 to 1938 at the school's Painting Studio, which was run by Dorothy Dunn.

Painter Pop Chalee of Taos Pueblo was one of Houser's friends and classmates during the time he attended the school. "He was a quiet boy, a little on the shy side, but a very sensitive and nice guy," says Chalee, who is now 85 and, like Houser, a past winner of a New Mexico Governor's Award, the state's highest honor for artistic excellence. Her description fits the image of Houser reflected in old photographs — a solemn-looking youngster clearly ill at ease in front of a camera that could not capture the wry humor, the hint of a smile, that underlies his still-serious manner.

OPPOSITE ►  
"Sunrise Song," 1982, bronze, edition of eight, 51"H by 11"W by 27"D.

Study from Houser's sketchbook.













Houser excelled in Dunn's program. Though he had never painted before — had only drawn with pencils and occasionally crayons — he learned the use of brushes, the application of color, so quickly that he soon won the studio's annual outstanding artist award.

"It was old-style, outlined, flat, strictly two-dimensional Indian art based on hide paintings, kiva and wall paintings," Houser says of Dunn's teaching. She once rebuked him for an early experiment in which he used shading to attempt a sense of three-dimensionality. "You had to do it that one particular way, and I was held back for a long time by the idea that if you didn't work that way you weren't doing Indian art. But I have to admit it was fun. I didn't particularly like the direction there, but it was getting me into the arts."

Houser turned to sculpture — the medium for which he is best known — at the suggestion of Norwegian muralist Olle Nordmark, with whom he studied in 1940 at the Fort Sill Indian School in Oklahoma. "I'd laid out a mural in charcoal," Houser remembers, "and Olle said the drawing looked massive, like sculpture." With tools provided by Nordmark, Houser began carving wood — and sensed he'd found his metier. "It grew on me," he says, "and I thought, 'this is what I've been wanting to do.'"

Houser pursued that new medium while teaching mural painting in Oklahoma and in Dulce, New Mexico; later, during World War II, he began carving small sculptures in soft stone as well as wood. In 1941, he moved to Los Angeles, where, with a wife and three young sons to support, he worked as a pipe fitter's helper, converting oil refineries to the production of synthetic rubber. Those war years challenged his artistic skills as he taught himself the techniques of sculpture, but the racial and ethnic prejudice he encountered during that period also tested his character and sense of self.

"I'd never seen so many people who hated blacks, Jews, Mexicans, Indians," Houser says softly, shaking his head, remembering the City of Angels. "Those construction people didn't pull any punches — they'd just say it right out, but they didn't say it to me." A fit-looking former amateur boxer, Houser grins broadly as he speaks. Although he is of medium height, his muscular frame makes him seem larger and, as a young man carrying substantially more weight, he must have been imposing. "I was pretty rough," Houser admits, "and I'd learned some dirty tricks — things that were done to me."

Like the blues musicians of his generation, Houser has known discrimination — the demeaning signs and comments and looks, that, he says, "make you feel like nothing." One incident



Allan Houser in his studio, 1986, working on plaster of a bronze entitled "Anasazi."

◀ OPPOSITE

"They're Coming," 1983, bronze, edition of 10, 23"H by 15"W by 8.5"D.



"Apache Warrior," 1982, bronze,  
edition of eight, 31"H by 51"W  
by 18"D.



OPPOSITE ►  
"Mountain Echoes," 1986, bronze,  
edition of eight, 38"H by 12"W by 6"D,  
base 26.5" by 16"; Below, Houser  
working on a model.

BELOW  
Study from Houser's sketchbook.



remains seared in his memory. It occurred around 1950 while Houser, his father, and a Chiricahua friend were traveling from Oklahoma to Juarez. Houser had recently completed his first monumental sculpture in marble (possibly the first ever by a Native American artist), at the Haskell Institute in Lawrence, Kansas, a stylized image of an Indian warrior commissioned as a memorial to the Native Americans who died in World War II. In addition to finishing that pivotal project, Houser had just won a major award from the Philbrook Art Center in Oklahoma and had received a prestigious Guggenheim Fellowship.

As an artist, he was riding high, headed to Juarez to celebrate that success, when they stopped to eat at a town somewhere in West Texas or eastern New Mexico. (Only the name of the place is missing from his otherwise painfully vivid recollection.) A sign in the restaurant window read, "No Negroes or Mexicans Allowed, and the waitress inside took one look and asked, "What are you folks doing here?"

"We told her that we weren't Negroes or Mexicans, that we were Indians from Oklahoma. She said she'd have to ask her husband, and he came out, and he said, 'You're right, but the rest of the people in here don't know that — come around to the back door and I'll make you some sandwiches.' My dad cursed him out. We tried two restaurants in





that town, and neither would serve us," Houser says, his voice tightly controlled, tinged with both anger and disgust.

"Here you've just accomplished something — the big job at Haskell, the awards; you're feeling proud and then something like this happens, not expected at all, and it makes you feel," he says, emphasizing again the devastation that such moments wreak, "like *nothing*, and it's a bad feeling. [Racism] is still there in a lot of places, just hidden now so you don't see it, but things have changed a lot." With that final comment, the stony expression on his face gradually relaxes.

It is in part because of forceful individuals like Houser, who have focused international respect on Native American accomplishments, that the times have begun to change. Houser's work has significantly expanded the horizons of Indian art, and he extended that influence in 25 years of teaching art at Indian institutions, first from 1951 to 1961 at the Inter-Mountain School in Brigham City, Utah, then at the Institute of American Indian Art in Santa Fe from its founding in 1962 until his retirement in 1975.

"A lot of the kids came with a hate for the white man because they'd been treated so badly in towns near their reservations — the restaurants and stores with signs that said, 'No Dogs or Indians,' that kind of thing," Houser says. "I told them that





"Hopi Maiden," 1983, Indiana limestone, 11"H by 18"W by 6"D.



I'd come from a similar situation and that what you had to do was start thinking about who you are and be proud of it — learn about your tribe, what they went through. You're an Indian and you should be proud of it — stand up for yourself."

Houser taught, in the time-honored, experiential Indian way, by example — "just by being and talking, by giving demonstrations," he says, transmitting not only his knowledge of artistic method but his vision of the richness, the inestimable value, of the Indian world, both past and present.

"I think that all I've witnessed, the stories my dad told me," Houser says, "gave me a lot of pride in who I really am and encouraged me to tell stories in my art. I felt strongly that I had something to offer, and I continue to do it in my own way. But it's not just storytelling — it has to do with being creative enough to do abstracts, to make things that are pleasing to me. It doesn't come easy; it needs a lot of experimenting, and it's hard to find something unique, that hasn't been done before."

Houser's ceaseless experimentation over the last half-century has brought him wide acclaim, including, besides his Guggenheim Fellowship, the *Palme d'Academie* award from the French government and inclusion in the Oklahoma Hall of Fame. Houser has exhibited throughout the United States and Europe; his work is included in the

British Royal Collection and those of such institutions as the Heard Museum in Phoenix, the Wheelwright Museum in Santa Fe, and the New Mexico Museum of Fine Arts, also in Santa Fe. His commissions include murals for the U.S. Department of the Interior Building in Washington, D.C.; his sculpture titled *Offering of the Sacred Pipe* graces the U.S. Mission to the United Nations in New York City.

Houser's example — as both an innovative artist and a man — has been an inspiration for several generations of younger Indian artists.

Jaune Quick-To-See-Smith, a noted Flathead Indian painter and Indian arts advocate who lectures widely on Native American contributions to world culture, calls Houser "the grandfather of sculpture in the Indian world. It had never before been done in stone in the major way he did it," the 51-year-old Corrales, New Mexico artist says. "I've seen sculpture as far away as Canada that was obviously influenced by his work. Yet, even with that stature, he's maintained his own character and you see continual growth in his work."

"If you think about the influence Picasso had on European art, that's the kind of impact Allan has had on the Indian world. He came through an era when it wasn't popular to be an Indian, when there was a lot of racial bias and there were a lot of hurdles to cross, but he just had this driving vision

OPPOSITE ►  
"Sacred Rain Arrow," 1988, bronze,  
edition of eight, 98"H by 59"W  
by 31"D.



that kept him going — a strength like the stone he carves.”

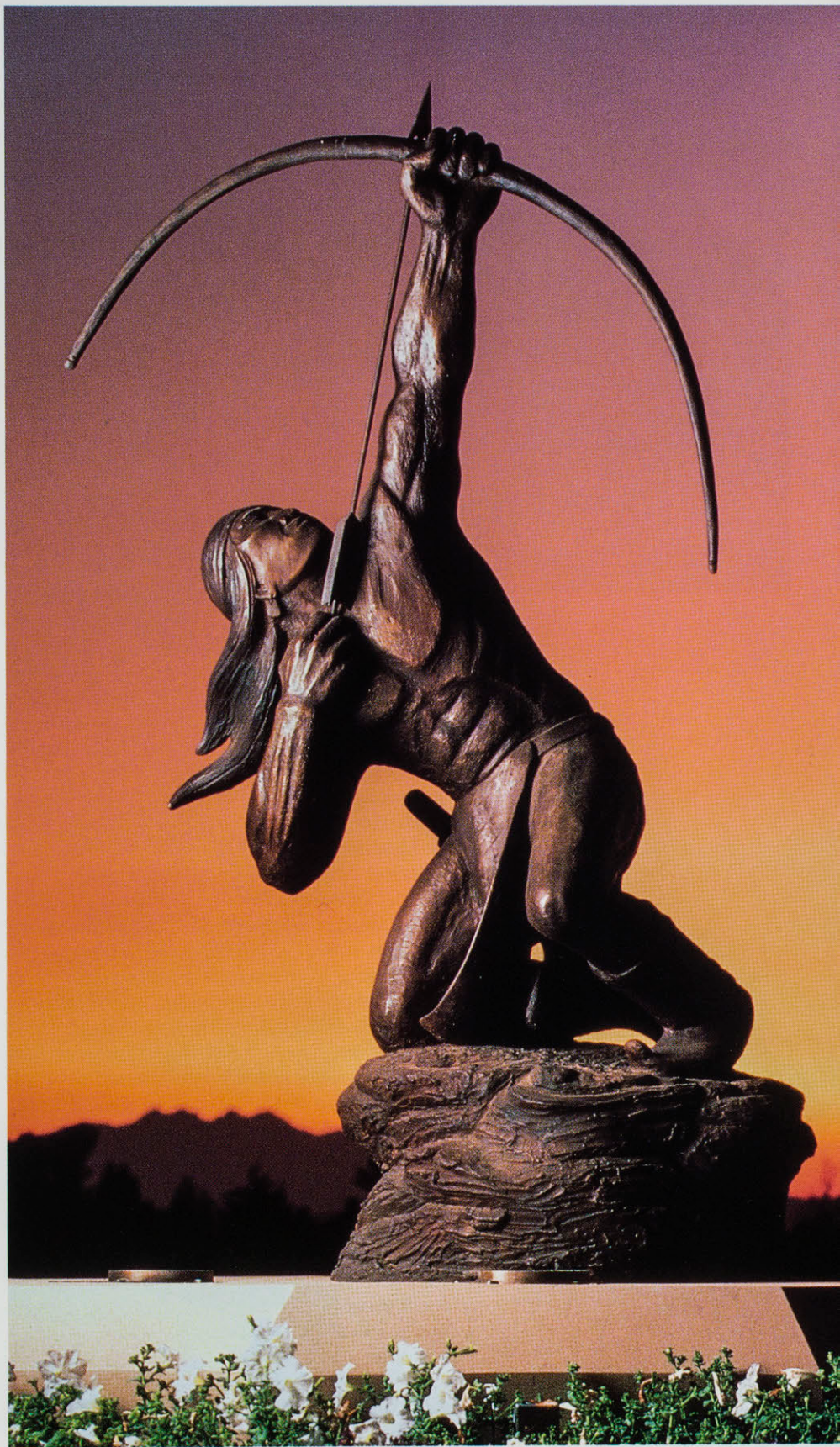
In her paintings and mixed-media works, Smith is an intensely political artist; Navajo painter Emmi Whitehorse, on the other hand, creates lyrical abstractions filled with enigmatic, personal symbols. Yet both, in their different ways, have answered Houser’s challenge to roll back the boundaries of art made by Indians, art that stems from Indian experience and concerns.

“Younger artists still look up to him,” says the 31-year-old Whitehorse, a Santa Fe resident. “He’s a giant, I guess you’d say, sort of like an old sage, always out there by himself and hard to categorize. He’s always been a loner, and people admire him for that. Most of us had to go into [contemporary art] half scared to death, trying to figure things out for ourselves — it’s sheer terror, and I’m sure it was the same for him. It makes it easier to know that someone else has gone through that process too, and I think everyone admires him because he’s made a whole life doing that.”

David Bradley, a 37-year-old Ojibwa painter who also lives in Santa Fe, works in a figurative, often sardonic political mode. Bradley attended the IAIA several years after Houser retired from teaching there, but Houser’s spirit, Bradley says, still imbued the school. “He was very much looked up to, was — and still is — a popular guy there,” Bradley says. “People still use his name with *respect*, and that’s amazing in the art world, which is a backstabbing business. Houser is sort of an elder in the Indian sense — someone who is wise, a traditional role model, someone who is venerated as an Indian. He showed that people can make it in the white man’s game, be a success in that context, but also be successful in the Indian context — can still keep their Indian identity, their *Indianness*.”

“There was a period when many Indians became afraid of painting or sculpting Indian imagery, but Houser was never ashamed of doing that. He just said, ‘Cut the crap, man — I’m an Indian and anything else I want to be.’ A lot of the old-timers associated with him out of the Dorothy Dunn era are spoken of in the past tense now, but Houser — Houser is still *peaking*.”

Houser’s art continues to evolve in the complex of buildings where he works with two assistants in the hills well south of Santa Fe, on Haozous Road, facing the Ortiz Mountains. There is a house filled with Houser’s sculptures and a design studio to which he retreats to draw and develop sculptural projects, to read, and to make music on the Indian flute, guitar, and harmonica. He is an accomplished blues harmonica player, a mode of expression he learned partly from listening to his father, who picked up this instrument during





"Mustangs," 1986, bronze, edition of four, 41"H by 60"W by 36"D.



the Chiricahuas' captivity in the Deep South, and partly from the blues recordings his children brought home. But Houser says he likes all kinds of music — from Indian groups to high-powered violinists, opera tenors, and Spanish guitar players. His 30-acre domain also includes an open kiva for storytelling sessions and an Indian dance ground to which Houser has brought Apache dancers from the Mescalero Reservation in southern New Mexico, where he has relatives.

Houser's creations in stone and bronze are set along a winding path through the piñon trees that cover his property, the elements of an ever-growing sculpture garden composed of pieces that are of particular importance to this artist — including his *Sacred Rain Arrow*, the bronze figure of a kneeling Apache brave, his muscles strained with the effort of drawing a bow aimed skyward. Another casting of this work, which is also featured in Houser's museum retrospective, was installed this year in the Senate Office Building in the nation's capital. The piece derives from one of the stories Houser heard as a youngster: "When the weather was dry," he says, "the Chiricahuas would send a strong man up on a mountain with an arrow that had been blessed by a medicine man, and he would shoot it up into the clouds, to bring rain." Nearby stands his *Earth Mother*, a woman and child in Houser's elemental figurative mode; a pair of seated Apache women in green-patinaed metal whose shapes echo those of the mountains looming beyond them, a Henry Moore-like bronze carefully

placed on a hillock of red earth.

But the most prominent structure here is Houser's tall sculpture studio. He stopped painting in the early 1970s (due to an eye problem that has been corrected), and since he retired from teaching he has committed his full energy to sculpture on an ever-larger scale in stone, bronze, and fabricated steel.

"I started out very realistic but got dissatisfied — wondered 'Where is Allan Houser in this?' — and started playing with design," he says, deftly encapsulating the desire for growth that has driven his art and kept it fresh. "Abstraction in my work has been coming on for the last 20 years — the urge to break an idea down and tell it in a simple way, make it speak but not lose the subject."

But whatever expressive mode or medium Houser chooses, that all-important subject, the core of his art and life, remains the story of the Indian world. That resonant song has, like the music called the blues, a universal appeal, but, also like the blues, holds a special meaning for the people whose culture and experience it evokes.

"It's about their beauty, their dignity," Houser says, "about showing, in my way, what I think of who I am, who they are — and making them proud."

*This article was reprinted with permission from El Palacio, the magazine of the Museum of New Mexico, vol. 96, no. 3 (Summer 1991). All photos courtesy of Glenn Green Galleries.*





"Prayer Song," detail.

"Prayer Song," 1983, bronze, edition of three, 82"H by 42"W by 52"D. Installed at Sundance Institute in Provo Canyon, Utah.



# The Ralph M. Parsons Insect Zoo

OPPOSITE ►

Although live animals are the stars of the Insect Zoo, it will also contain displays reviewing the evolution and biology of insects and other arthropods, and examples of fossil animals (similar to those at right) from the museum's Invertebrate Paleontology collection. From the top: A dragonfly nymph, head down, in a siltstone nodule from the Barstow Formation of the Calico Mountains in San Bernardino County. This specimen is of early Miocene age, about 21 million years old. Next, *Parajulus lasti*, a late Miocene millipede (around 10 million years old), curls under a sparkling encrustation of calcite crystals. It was found in a well in the vicinity of Oxnard. The delicate wings of *Celithemis cellulosa*, a 30-million-year-old dragonfly from the Oligocene Epoch, are perfectly preserved in a very fine-grained shale from hills near Bonn, Germany. Two March flies, *Plecia exposita*, came from exposures of the same Oligocene shale near the Rhine River.

WITH THE OPENING OF THE Ralph M. Parsons Insect Zoo, a longtime vision of the first permanent insect zoo in southern California has become reality at the Natural History Museum.

People have long been interested in insects, drawn at first perhaps by the desire to confront deep reactions of fear (negative responses to insects seem almost instinctive after eons of contending with bites, stings, and infestations). But an equally powerful attraction is the queer, extravagant beauty of insects. They are novel, bizarre, and utterly fascinating in their profundity of sizes, methods of locomotion, and survival strategies.

Insects were among the first land animals. They exist in the fossil record from at least 400 million years ago and have since adapted to every conceivable environment, from blistering desert dunes to the Great Salt Lake to the heart of the Arctic. Over the ages, they have taken on an astounding variety of shapes, colors, and functions. They form the basis of all terrestrial food chains and are therefore of extreme importance to humans.

Since the early 1950s, the museum's entomologists have felt that the people of Los Angeles should have a place to observe and study live insects. Although Europe and Asia have had such facilities for at least a century, no such enterprise existed in the U.S. because American museum philosophy traditionally held that live exhibits belonged in zoos, not museums. That custom was broken in 1976, when the Smithsonian Institution proved that an insect zoo could fit into the framework of museum programming. Discussion and planning were reignited at our museum after that success, and in late 1988, the Ralph M. Parsons Foundation accepted our proposal and granted funding for initial construction and first-year operation.

Visitors to the new Insect Zoo, an adjunct exhibit to the Parsons Discovery Center, will find over 30 species of living arthropods, insects, and crustaceans, accompanied by handlers who demonstrate the animals' movements and morphology for onlookers. In the zoo's 2,900-square-foot gallery, displays teach about insect diversity and ecology, classification, life cycles, defense mechanisms, and social structures.

Current exhibit technology will be used to demonstrate how insects eat and digest their food and how they sense their environment through sight, sound, smell, and touch. The exhibit includes imaginative and amusing presentations, such as a refrigerator that opens to reveal foods found by insects in their habitats, such as bark and

leaves, and foods they find in human habitats — such as sweat and blood.

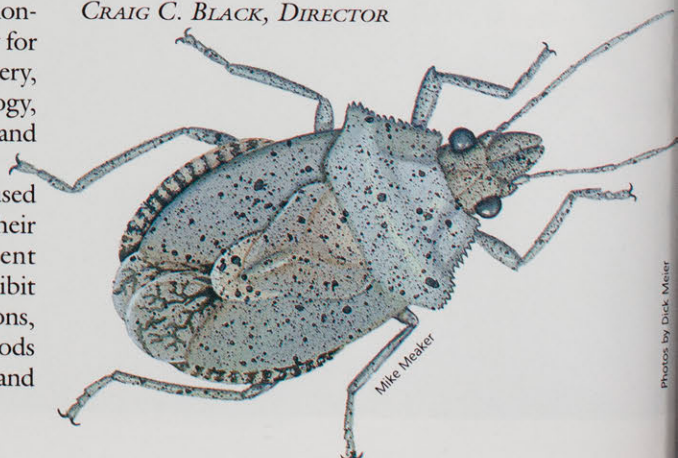
An ecology exhibit tracks the fading habitats of the more than 100 butterfly species that inhabit the Los Angeles Basin. Another explains how insects can be indicators of pollution, and tells what conservation measures can be taken. A free-standing exhibit gives information on the study and collection of insects. Vivid graphic displays emphasize diversity, showing that insects outstrip every other living thing on earth in terms of mass, numbers, and types. At the same time, suggestions are made for controlling pests in a non-destructive manner.

In 1989, Dr. Arthur Evans was appointed director of the new facility, and three years of plans, exhibit outlines, research, and blueprints followed. Dr. Evans' interest in insects began in kindergarten, continued through high school when he was a student worker in entomology at the Natural History Museum, and resulted in his earning a doctoral degree in entomology from the University of Pretoria in South Africa in 1988. Dr. Evans brings to the position of zoo director a commitment to education, a singular affinity for all animal life, and a strong advocacy of global biodiversity.

The Natural History Museum houses over five million insect specimens, including the world's largest collection of southwestern moths and butterflies, and North America's largest collection of ants. Specimens were displayed for years in the Insect Hall, which was dismantled in 1984 to make way for museum renovation. With the opening of the Parsons Insect Zoo and the addition of live animals, the museum will house one of only four such major projects in the country.

For the 250,000 children who are estimated to visit the Ralph M. Parsons Discovery Center each year, the Parsons Insect Zoo is an outstanding gift.

CRAIG C. BLACK, DIRECTOR









# Bug Husbandry at the Insect Zoo

by Arthur V. Evans

*"If all mankind were to disappear, the world would regenerate to the rich state of equilibrium that existed 10,000 years ago. If insects were to vanish, the environment would collapse into chaos."*

E. O. WILSON

*"They're just bugs."* ANONYMOUS

**T**HIS SPRING, THE RALPH M. PARSONS Insect Zoo opened at the Natural History Museum, allowing visitors to this permanent exhibit to investigate the creatures that are the most numerous on earth, with more than a million and a half known species and up to 27 million more unknown.

Many people, especially in urban settings, tend to have a less than sunny view of insects, often dismissing them all as pests. And indeed, since the beginning of recorded history, insect-borne diseases such as malaria and yellow fever have killed more people than all wars combined; insects also destroy as much as half of the food grown for human consumption. Yet these "pests" are the underpinning of all land-based food chains, providing fodder for reptiles, birds, fish, and some mammals, including people. Found mostly in the world's rain forests, which are vanishing swiftly at the hands of humans, insects are the chief pollinators of flowering plants, upon which all other beings depend for oxygen, food, and clothing. And contrary to their reputation as enemies of mankind's fortune, only 1% of all known species are considered to have a negative impact on the human condition.

Despite their importance to us and the environment, we still know very little about insects and their fellow arthropods — arachnids, millipedes, centipedes, and crustaceans. The Insect Zoo uses live and preserved arthropods, as well as interactive exhibits, to reveal the diversity of these

animals and the critical role<sup>s</sup> they play in various ecosystems. Over 30 species of arthropods are maintained at the zoo's temperature- and moisture-controlled insectary. They are collected in the field annually or purchased from dealers; about half of the zoo's species are collected in southern California and southeastern Arizona. Insects are hardy and easy to keep in captivity, and their life cycles often unfold within a school semester, making them ideal for the study of natural history. Throughout the zoo's 2,900-square-foot display area, the latest exhibit technologies are used to demonstrate some of the ways in which insects have fine-tuned themselves to become the earth's most abundant creatures.

Arthropods require much less care than other kinds of pets, though it is not as simple as buying a 100-pound bag of bug chow and tossing in a kibble every now and again. If they are to thrive, arthropod colonies require daily care. These animals often have very specific food and habitat requirements. There are very few guidebooks on keeping arthropods in captivity, but several rules have emerged from experience at the country's insect zoos.

Arthropods may be kept in many different types of containers, but all must have secure lids and good ventilation. They must be kept out of direct sunlight and away from too many disturbances. Containers must be large enough to allow animals to roam about freely.

Of the 4,000 species of cockroaches known, the vast majority perform a vital function in the environment by breaking down plant and animal materials into basic components that can be used by other plants and animals. Only about 20 species are considered pests.



Don Meyer



Soil type should be similar to that where the animals are found; peat moss, sand, gravel, potting soil, and paper towels may be used. It is important that soils be free of pesticides, oils, detergents, and other chemicals that might be harmful to arthropods. Soils should never be reused, as this can promote the spread of diseases, parasites, bacteria, and fungi. Additional terrarium or aquarium furniture may include rocks, bark, branches, or plants. The objective is to recreate a natural environment for the animal.

Fresh water is critical since most arthropods will dehydrate before they starve. Although many arthropods obtain water through their food, it is essential to provide a dish of water to maintain comfortable humidity levels in the container. In the wild, arthropods move about to find suitable temperature and humidity levels. Most live on plants or in burrows where the humidity is fairly high. Even desert arthropods live in places where moisture levels are much higher than those found out in the open. By providing a dish of water or by misting, you can create a moisture gradient and allow them seek their own comfort zones. We always use distilled water in the Insect Zoo to avoid toxic chemicals that might be found in tap water; it also reduces mineral deposits on glass surfaces. We keep our animals at relative humidity levels of 40-50%.

Temperature is also critical; activities such as feeding, molting, and reproduction are inhibited by temperatures that are too high or too low. Most of the colonies at the Insect Zoo thrive between 75 and 85 degrees Fahrenheit (24-30 degrees Celsius).

Uneaten food, dead arthropods, and waste must be removed daily to prevent disease, mold, and the establishment of arthropod pests such as grain beetles, drosophila flies, and mites.

The following techniques are used to maintain some of the more popular arthropods kept in captivity at the Insect Zoo.

## CRICKETS

### Class Insecta, Order Orthoptera

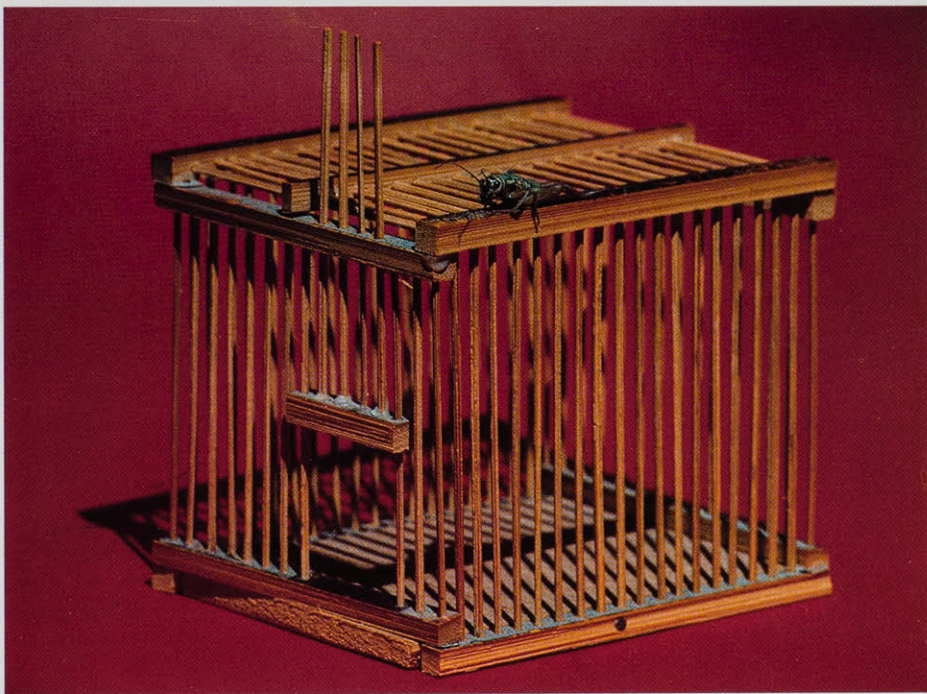
Crickets are easy to obtain and fun to watch and listen to, and they serve as a staple food for nearly all other kinds of arthropod predators. No summer evening is complete without a chorus of crickets. Filmmakers commonly dub in the sounds of crickets to create the mood for an evening setting. In ancient China, crickets were thought to bring good luck, and were often kept in bamboo cages so that their songs could be heard indoors. Cricket fighting was also popular, and victorious crickets were sold for the same prices as horses. Famous or especially loved crickets are reported to have been buried in silver caskets upon their deaths.

The house cricket, *Acheta domesticus*, is a native of Europe and is commonly sold in the United States at pet shops and bait stores. It can be found in various sizes, from pinheads (so called because of their small stature) to adults. A mature female is easily recognized by the long egg laying tube, or ovipositor, extending from the end of her body. Each of the male's front wings contains a ridged structure called a file. Males rub these files across one another, which results in the familiar chirping sound whose purpose is to attract mates.

Crickets should be kept in a large, well-ventilated container with paper toweling on the bottom to allow for easy cleaning. They need a regular source of clean water. A shallow water dish filled with cotton maintains humidity and prevents smaller animals from falling in, drowning, and fouling the water. Crickets can thrive on apples, potatoes, sweet potatoes, carrots, romaine lettuce, bran, flaked fish food, and dry dog food.

A shallow container (one or two inches deep) filled with moist sand will provide a site for egg laying. Eggs hatch in three to four weeks. The young pinheads feed on the same foods listed above, sprinkled with crushed dry dog food. Cricket nymphs (and all other arthropods) grow by molting — shedding their outer skeleton. Right after each molt, the young crickets are white. The newly formed exoskeleton darkens as it hardens, and within a few hours the cricket will be its usual brown color. At 80 degrees Fahrenheit (26.6 degrees Celsius), crickets take about two months to mature.

House crickets are easy to obtain and care for. Some people keep them just for the pleasure of their song, while others consider them pests.



Don Meyer



A hungry female mantid will often devour her mate, even while in copula.

## PRAYING MANTIDS

Class Insecta, Order Mantodea

Mantids are easily recognized by the position in which they carry their front legs, like a person in prayer. In fact, the word mantis means prophet or soothsayer in Greek. The front legs, armed with sharp spines, close together like a trap to capture prey, which consists primarily of insects. Mantids are found throughout the world and are strictly predatory, eating only other insects.

While they are being laid, mantid eggs are surrounded by a foamy substance that later hardens into a protective coating. This egg case, or ootheca, varies in size and shape depending upon the species of mantid, and may contain up to 200 eggs. The ancient Chinese believed that mantid egg cases could cure belching, impotence, low sperm count, absence of menstruation, gonorrhea, asthma, bed wetting, and other afflictions.

Mantids are camouflage artists, colored and shaped to look like leaves, orchids, and tree bark. This conceals them from both predators and prey. The Malaysian deadleaf mantid, *Deroplatys dissimilata*, lives up to its name and virtually disappears when perched among dead leaves.

The Chinese mantid, *Tenodera aridifolia*, is the largest in the United States. It was introduced around the turn of the century near Philadelphia, and has since become common on both coasts. The egg cases of the Chinese mantid are often sold in nurseries and biological supply houses to gardeners



Charles Hogue



to control pests on their plants, for the young hatch with a voracious appetite for aphids.

Mantids are kept in large, well-ventilated containers; a small plant or branch will provide a suitable resting place. Potting soil, pine shavings, or paper towels are good substrates. Mantids must be provided with live flies, crickets, grasshoppers, moths, and mealworms. Food items should be offered by holding them with forceps in front of the mantid; immobile insect bodies on the bottom of the container are usually ignored. Adult mantids must be fed every other day. In addition to containing a dish of water, their enclosure should be misted daily. Mantids will drink from screened lids or from droplets on the sides of the glass.

Raising mantids from eggs can be difficult; because of their tiny size, nymphs are difficult to feed. Since young mantids are cannibalistic, however, simply letting them feed on their siblings for several weeks will reduce their population to a manageable number. At this point, the nymphs should be separated and fed fruit flies (*Drosophila melanogaster*), pinhead crickets, or aphids. Mantids will not accept food that is too large.

## COCKROACHES

### Class Insecta, Order Blattodea

Cockroaches are among the world's oldest inhabitants. They have remained virtually unchanged for the past 350 million years. Of the 4,000 known species, only about 20 species are considered to be

pests. The remaining species perform a vital environmental task by recycling plant and animal materials into nutrients that can be utilized by other plants and animals.

Morphological, biological, and behavioral characteristics indicate that ancient cockroaches were the ancestors of termites. Both cockroaches and primitive termites rely on intestinal and intracellular symbionts to digest their food and will quickly starve if these microorganisms are removed or destroyed.

The American cockroach, *Periplaneta americana*, is one of the most common in the U.S. It prefers warm, moist locations and is often a pest in warehouses, restaurants, grocery stores, bakeries, packing houses, hotels, hospitals, and prisons, where it commonly infests food storage and preparation areas. The American cockroach is the predominant species found in sewer systems in the U.S., but it is rarely very abundant in homes (that species is the German cockroach, *Blattella germanica*).

Eggs are enclosed inside an ootheca and are carried by the female for several days before being dropped near a food source. The eggs hatch in a month or two and the young take several months to mature. Adult American cockroaches may live two or three years.

Cockroaches are easy to keep in captivity; in fact they are one of the few arthropods at the Insect Zoo that thrive in spite of us, not because of us. They eat just about anything, including paper and



The rigid bodywalls of insects and other arthropods present a problem when the animal grows. It must shed its exoskeleton, including its breathing tubes, foregut, hindgut, and internal support structures. The new exoskeleton, soft and pale, will harden and darken in a few hours.





Hissing cockroaches are easily handled by children. Some individuals may reach nearly three inches in length.

glue, but a varied diet of lettuce, apples, oranges, grapes, bread, bran, flaked fish food, and dog biscuits insures a thriving colony. As with other arthropods, feed daily, remove waste and uneaten food, line the bottom of the container with paper towels, and provide a water dish. A narrow strip of petroleum jelly wiped along the inside top of the container will keep nymphs and adults from gathering around the lid.

Some cockroaches have a rather pungent odor, which can only be subdued by regular cleaning of their enclosure.

The hissing cockroach from Madagascar (*Gromphadorhina portentosa*) is ovoviviparous — the egg case is brooded within the female reproductive tract. After about two months of incubation, up to 48 nymphs emerge from the ootheca over a period of two days. These young have a habit of congregating along the rim of the container.

#### GIANT WATER BUGS

##### Class Insecta, Order Hemiptera

Giant water bugs, or “toe biters,” of the genus *Abedus*, are known for a curious behavior: the female lays her eggs on the back of the male, who carries them until they hatch several weeks later. Many people refer to the oriental cockroach as a water bug, because of the latter’s habit of moving among dwellings via plumbing systems. But cockroaches have chewing mouthparts, in contrast to the piercing/sucking mouthparts that characterize the giant water bug and its relatives, the true bugs.

Giant water bugs are usually found in ponds or quiet pools in streams, although they do

fly and are occasionally seen around lights at night. Despite their large size, they are usually not conspicuous, as they are camouflaged among plant detritus in the water.

Giant water bugs feed on aquatic insects, small tadpoles, and fish. In captivity, they will take crickets and mealworms directly from forceps. Their long, beaklike mouthparts inject an enzyme into the victim, killing it and partially digesting the internal organs. The “soup” is then sucked out and the carcass tossed away.

Most aquatic insects breathe by trapping a bubble of air somewhere on their bodies. Giant water bugs break the surface of the water with two straplike snorkels at the tip of the abdomen. A reservoir of air is then trapped beneath the wings and the abdomen.

A single giant water bug may be kept in a gallon jar. Tap water should be allowed to stand at least 24 hours before introducing livestock to the tank. Four or five adults may kept in a 10 gallon aquarium. An under gravel filter is sufficient for keeping the water clear, but a 25% water change is recommended every two weeks. This prevents the buildup of poisonous ammonia that is released from the animal’s waste products. Gravel must be thoroughly rinsed before it is placed into the aquarium to reduce the quantity of suspended particles clouding the water. An inch-thick layer of gravel is sufficient to securely anchor plastic plants. Plants and submerged stones are necessary to provide the bugs with places to hide and rest.

Males carrying eggs should be placed in a separate tank until the eggs hatch to reduce the number of young eaten by other adults. After hatching, return the male to the main tank. Young bugs will feed on small insects, such as pinheads, fruit flies — and each other.

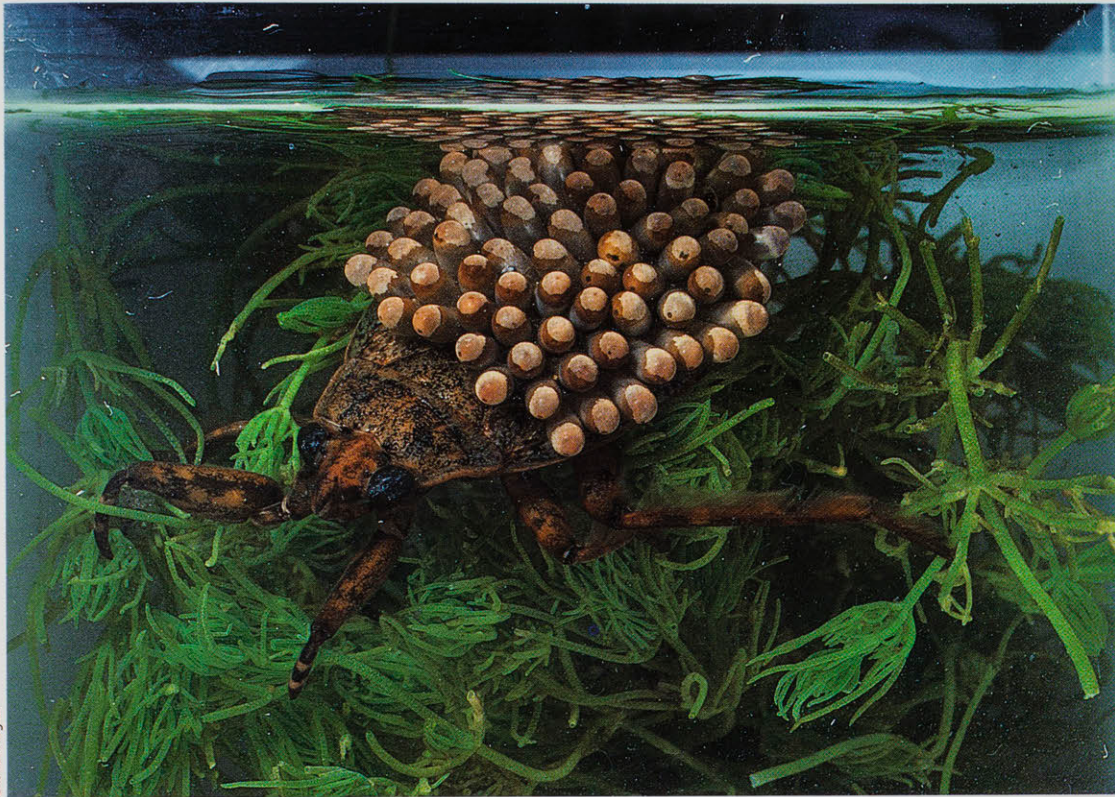
#### MILLIPEDES

##### Class Diplopoda

There are perhaps 10,000 species of millipedes, 180 of which occur in California. They occupy desert and tropical regions, where they feed primarily on decaying vegetable matter. Millipedes, and their relatives the centipedes, have a distinct head followed by a long segmented trunk. Millipedes possess two pairs of legs on most body segments, instead of one pair as with centipedes. Unlike centipedes, millipedes are not venomous. Some millipedes exude a foul-smelling fluid when disturbed, while others defend themselves by rolling up into a coil. Pill millipedes, like pill bugs (Class Crustacea), can roll themselves into a ball. Millipedes may live from one to ten or more years, depending upon the species. Some millipedes are less than one inch (2.5



Charles Hogue



The male giant water bug carrying eggs.



Don Meyer

The desert millipede assuming a typical defensive posture. Millipedes feed on plant foods such as the grape nearby.

centimeters) in length while some tropical species may exceed six inches (over 15 centimeters).

Eggs are laid in the soil and take several weeks to hatch. Newly hatched young usually have only the first three pairs of legs and not more than seven body segments. With each new molt, new legs and segments are added. Some species of millipede may have more than 700 legs when mature.

A spacious container with moistened potting soil and peat moss on the bottom is ideal for tropical species. Coarse sand may be substituted for desert species. Provide a water dish and mist the tank daily. Most millipedes will feed on a variety of plant foods, including romaine lettuce, spinach, tomatoes, sweet potatoes, bananas, and grapes (cut in half). Because of their herbivorous preferences, several millipedes may be kept in the same container without the danger of cannibalism. Millipedes do not bite and are safe and easy to handle. Some species may secrete a noxious fluid that may be washed off with water.

In southern Arizona, the summer monsoons cause the desert millipede, *Orthoporus ornatus*, to emerge by the thousands, sometimes causing highways to become slick with their crushed bodies.



Charles Hogue



TOP

*Scolopendra polymorpha* is one of the larger species of centipedes found in the southwestern United States.

BOTTOM

Sperm transmission in centipedes is indirect. The male produces a spermatophore and places it in a web of silk strands. The female picks up the spermatophore and places it in her reproductive opening. *Scolopendra heros* lays 15-35 eggs and protects them by wrapping her body around them. The young centipedes hatch fully formed and may remain with the mother for several days.

## CENTIPEDES

### Class Chilopoda

Centipedes are found throughout the world, in both temperate and tropical regions. They are usually encountered beneath humus, rocks, bark, and logs, and move very quickly when disturbed. About 3,000 species are known to science. Centipedes have one pair of legs per body segment and are venomous. The first pair of legs are modified to serve as poison fangs and the claws are hollow and attached to poison glands.

All centipedes are predators, with small arthropods forming the major part of their diet in nature. They also consume earthworms, snails, and nematodes. Centipedes usually locate their prey with their antennae or their legs. The prey is then captured and killed or stunned with the poison claws. Centipedes are not considered dangerous to humans, but their bite can be very painful, so they should be handled only with forceps.

Some centipedes display parental care. Females of the largest centipede in North America, *Scolopendra heros* (up to 10 inches, or over 25 centimeters, in length) will lay a clutch of 15 to 35 eggs and then wrap themselves around the clutch. This behavior continues until the eggs hatch and the young begin to disperse.

With proper care, centipedes live for several years. They should be kept in a container that is taller than their body length so they can't escape. A substrate of moist sand mixed with potting soil seems to work best. Centipedes like to burrow and will remain hidden during daylight hours if the substrate is deep enough.

Provide fresh water in a dish to maintain relatively high humidity in the container. Centipedes will drink water droplets from rocks and the sides of the container. In captivity they will eat a wide variety of small animals, especially crickets, mealworms, and beetles.

## TARANTULAS

### Class Arachnida, Order Araneae

Tarantulas are probably the most commonly kept arthropods. Their long life spans and ease of care make them ideal pets. Tarantulas (also known as "bird spiders" or "monkey spiders") and trapdoor spiders belong to the group known as mygalomorphs, which are relatively large spiders found throughout the most of the world. Most mygalomorphs stalk or lie in wait for their prey, which consists of small animals, usually insects or other arthropods but occasionally vertebrates such as small reptiles. Despite their fearsome appearance, tarantulas seldom bite. The venom of most North American species is no more potent than that of a bee sting.

Tarantulas become sexually mature in eight to 10 years. The young tarantulas usually remain close to their burrows, venturing out only occasionally in search of food. Mature males are often encountered in the deserts and foothills in summer and fall, walking about in search of food and females. These males will live only until November or December. Mature females are generally less active and remain in their burrows. They will live a total of 20-25 years. Male and female spiders appear identical when immature. Upon reaching maturity, a male possesses on his first pair of walking legs a set of hooks used to hold the female's front legs during mating so that she won't eat him.

Immature tarantulas may molt several times a year. Mature individuals molt once a year, usually in the spring. Tarantulas become lethargic a few weeks before molting and show little interest in food. Just before molting the tarantula will lie motionless on its back. If you see your tarantula on its



Charles Hogue



Steve Prchal



back, do not move it, since it is very vulnerable at this time. Any disturbance may result in the injury or death of the spider. Interestingly, tarantulas always die on their feet.

Tarantulas should be kept in a large plastic sweater box or five gallon aquarium. A secure lid is essential, since tarantulas are escape artists. They can climb up glass and are strong enough to push off a loose-fitting lid. Coarse, dry sand is all that is needed as a substrate, although rocks or cactus may be added. Tarantulas will dig a burrow if provided with enough soil. They are nocturnal and will usually hide during the day. A paper towel tube or curved piece of wood will give your spider a place to hide. Tarantulas take in moisture from their food, but a small dish of fresh water should be provided daily to insure proper humidity levels.

Never place more than one tarantula in a cage. Tarantulas are fierce predators, and placing them together will only result in injury or death.

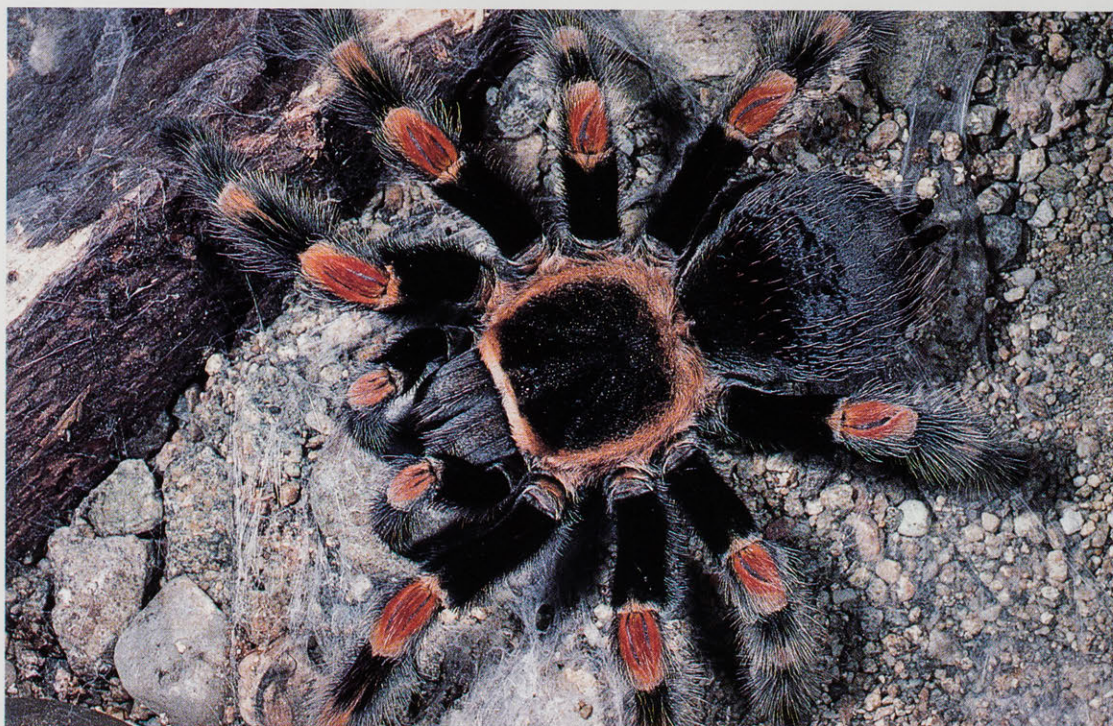
Crickets are commonly used as tarantula food because they can be easily obtained. Most cricket dealers feed their crickets apples or potatoes, which are high in carbohydrates but low in proteins. It is a good idea to feed your crickets flaked fish food to increase their protein content, particularly before feeding them to your predators. Never collect insects around your home to feed to your tarantula; unless you know that they are free of insecticides, it is safer to buy them.

When a tarantula feels threatened, it will

use its hind legs to kick urticating hairs from its abdomen. Some people are very sensitive to these hairs and a red, itchy rash may appear on their skin. Tarantulas that exhibit this behavior should not be handled. Male tarantulas are much more aggressive than females, and the latter are usually preferred for handling. Tarantulas do not need to be held, but if you do handle them, be sure that they are placed on a flat surface, such as your hand. Never let a tarantula walk up your clothing or sit on your shoulder. If it falls to the floor, its body will break open like a piece of ripe fruit and it will bleed to death.

One of the most beautiful tarantulas is the red-knee tarantula, *Brachypelma smithi*, from Mexico, but over-collecting of this species as an exotic pet and the destruction of its habitat have resulted in the destruction of its natural colonies. After mating, females of this species will lay 200 to 400 eggs in a silken egg sac. The young spiders hatch in about two months and remain with the mother for about three to four weeks before dispersing. Predation and other natural causes may account for a mortality rate of up to 98% in young spiders.

The name "tarantula" originated in the town of Taranto in southern Italy. During the Middle Ages, a strange malady known as tarantism was erroneously attributed to the bite of a large spider (the wolf spider, *Lycosa tarantula*, a distant relative of mygalomorph spiders). The symptom of — and cure for — this affliction was a wild dance to exhaustion. This misnamed affliction is the origin of the Neapolitan folk dance, the Tarantella.



Maggie, the red-knee tarantula, is one of the original tenants of the Insect Zoo. She is at least 22 years old.

Charles Hogue



TOP

An emperor scorpion. Scorpions are among the oldest known land dwellers, with a fossil record dating back 400 million years.

BOTTOM

At birth, young scorpions immediately crawl up on their mother's back. The young scorpions will remain until their first molt, which occurs about a week after birth.

## SCORPIONS

### Class Arachnida, Order Scorponida

Scorpions are commonly found throughout desert and tropical regions. Of the estimated 1,437 species, 65 are known from the United States. Of these, only seven species are found east of the Mississippi River, while 40 live in California.

Fossil evidence indicates that scorpions may have been the first arthropods to successfully colonize terrestrial habitats. Their fossil record dates back 400 million years. At this time scorpions were aquatic and possessed gills. Some Carboniferous scorpions were nearly three feet (almost a meter) in length. The largest living scorpion is the

African emperor scorpion which reaches seven inches (nearly 18 centimeters) in length.

Scorpions possess a pair of unique sensory appendages known as pectines. The pectines are attached ventrally to the second abdominal segment. Each pecten is comblike in appearance and is very sensitive to vibrations of the substrate. These structures enable scorpions to locate their prey, which consists mainly of arthropods. Large species may attack and consume small lizards. They are also characterized by a long segmented tail terminating in a sting.

Courtship in some scorpion species is quite elaborate. The male and female face each other and arch their bodies into the air. Eventually the male seizes the female with his clawlike pedipalps and walks backward and forward. This behavior persists for several hours or days until the male deposits a spermatophore, or sperm packet, on the ground. The female is maneuvered over the spermatophore, triggering the release of sperm, which is then taken up into the female's genital opening.

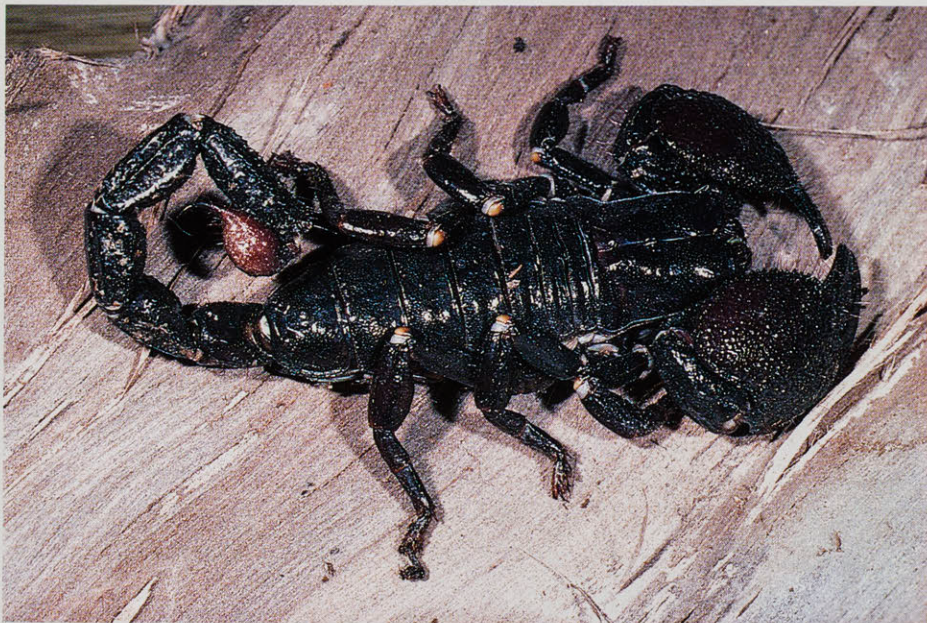
Scorpions are either viviparous (live bearing) or ovoviviparous. Up to 90 young may be produced, depending upon the species. At birth, they immediately crawl onto the mother's back, where they remain through the first molt.

Scorpions may be collected by searching beneath objects or by pitfall trapping (digging a hole and placing in it a vessel whose lip is flush with the ground) in the chaparral or desert. Searching for scorpions with a blacklight at night is also an effective method, since scorpions fluoresce under ultraviolet radiation.

The African emperor scorpion, *Pandinus imperator*, can be bought in pet stores and is often used in the movies because of its large size and docile behavior. The emperor scorpion can be handled, but it is not recommended. Although its sting is not considered dangerous, its pedipalps can inflict a painful pinch. Since it is native to a tropical climate, high moisture levels must be maintained in this species' container; moistened potting soil works best. Emperor scorpions kept under desert-like conditions will die a slow death from dehydration.

One or two crickets per week are enough to satisfy these animals. Prey is captured with the pedipalps and eaten. Emperor scorpions can be maintained in groups, as long as all of the individuals are about the same size and are well-fed. Emperor scorpions will live several years in captivity.

Local scorpions, such as the large desert hairy scorpions of the genus *Hadrurus*, are best kept on sand or gravel in containers secured with a screened lid. Never place North American scorpions together in the same container, since they will



Charles Hogue



Steve Prchal



feed on each other as they do in nature. In general, scorpions should only be handled by carefully grabbing the tail with a pair of forceps.

**F**OR NEARLY 20 YEARS, ENVIRONMENTALISTS have warned us about the destruction of such exotic places as the Amazonian rain forest, the African savanna, and the Great Barrier Reef. It always seems as though the devastation is happening only in these alien, faraway places — in short, “somewhere else.” But environmental destruction is not limited to just these kinds of places; it is occurring at an alarming rate globally, including in our own back yards. If we could learn to notice and appreciate the biodiversity that does still exist all around us, we would surely be more motivated to protect Earth’s habitats. By “thinking globally and acting locally,” we, as a species, can effect positive environmental change.

Insect zoos such as that at the Natural History Museum introduce people directly to the fragility and wonder in our own urban or rural surroundings. Our Insect Zoo provides a closer look at a world literally beneath our feet; by observing the arthropods that share our homes and gardens, we can begin to see that an intricate web of life circles the earth. We may realize that the destruction of any environment is directly relevant to our own, and has an impact on our everyday lives.

*The Insect Zoo at the Natural History Museum is the result of generous support provided by the Ralph M. Parsons Foundation.*

*Arthur V. Evans is the Insect Zoo Director at the Natural History Museum. He studied entomology at California State University, Long Beach, where he received a bachelor’s degree in entomology and master’s degree in biology. He spent three years in South Africa, where he attended the University of Pretoria and earned his doctoral degree in entomology. Dr. Evans has published 14 scientific papers on the systematics and biology of scarab beetles.*

## Have Bugs, Will Travel

**T**he Insect Zoo is unique in the United States in that it sponsors five outreach programs that reach 50,000 people annually. **The Insect Fair**, held in the spring at the State and County Arboretum in Arcadia, provides information on home and garden pest control, exotic pest outbreaks, insect collecting, and tropical biology.

The popular **Traveling Insect Zoo** visits schools, summer camps, shopping centers, and fairs two or three times a week throughout the year, and has been featured on several local television stations.

**Insects on Parade**, held during the summer at various locations throughout Los Angeles County, includes bugwatching hikes, construction of bug condos, and bugwatching under the stars, among other family activities.

**Tracking the Monarch**, a butterfly tagging program held each December and January, is led by Insect Zoo staff. Museum members and their guests travel to one of California’s largest monarch overwintering sites near Santa Barbara and study the monarch’s migratory patterns and overwintering behavior. Participants place adhesive tags on the right forewing of selected butterflies. Each tag bears a reference number and instructions to return the butterfly to the Natural History Museum for further study.



Dick Meier



Dick Meier

**On Safari in the Urban Jungle** introduces educators to entomology with slides and live arthropods such as tarantulas, millipedes, centipedes, praying mantids, and desert ironclad beetles. Teachers study insect ecology, evolution, development, behavior, internal and external anatomy, and classification. The workshop demonstrates both the suitability of insects as agents of science education, and the simplicity of maintaining them in the classroom.



John DeLeon



# Jewels of the Tropics

by Wayne P. Armstrong

**H**UMANS HAVE BEEN DECORATING their bodies with natural objects for thousands of years. Primitive man wore necklaces made from the bones, claws, and teeth of slain animals. Today most people think of natural jewelry as pearls, shiny pieces of coral, or precious or semiprecious stones, polished and set in gold or silver. But some of the most unusual and striking jewelry in the world comes from plants, and in terms of aesthetic beauty and intrinsic value, plant jewelry may rank as high as any gemstone. Exotic seed necklaces from native cultures throughout the world often come with fabulous tales about their origins and legendary uses.

Most botanical jewelry is made from seeds which are drilled and strung into necklaces and bracelets. Large spectacular seeds are often used for pendants. Generally, the most durable and colorful seeds are used, although striking necklaces made from ordinary beans, corn grains, acorns, and a common tropical grass called Job's tears (*Coix lacryma-jobi*) can be purchased in Mexico. In Costa Rica and Belize, unusual necklaces are made from the woody thorns of certain species of acacia, including *Acacia cornigera* and *A. collinsii*. In the acacia scrub forests, some of these hollow thorns actually serve as "condominiums" for symbiotic

ants that vigorously protect the trees from browsing mammals and destructive insect pests. For this service the tree supplies the ants with carbohydrate-rich nectar secretions from its leaf stalks, and nutritious lipid-protein morsels called Beltian bodies from its leaflet tips.

Indians of the southwestern United States and Mexico made necklaces from a variety of interesting native seeds, including angular brown seeds from juniper berries (*Juniperus monosperma* and *J. osteosperma*) and the black, marble-like seeds of Texas buckeye (*Ungnadia speciosa*) and western soapberry (*Sapindus saponaria*). The soapberry tree has a remarkable distribution throughout southern Arizona, New Mexico, and Texas, extending southward through Mexico into Central and South America. Each soapberry seed, often called a "black pearl," is produced in a leathery brown berry containing toxic saponins. Saponins are a group of glycosides containing glucose or a related sugar plus a toxic triterpenoid component. They have the unusual property of foaming with water, and soapberries have been used as soap in Mexico and tropical America. In addition, saponins are especially toxic to cold-blooded vertebrates, and crushed soapberry fruits were thrown into ponds and streams to stupefy the fish so that they would float to the surface to be gathered.

Unusual necklace from the Amazon River of Peru, made from seeds, human teeth, and a dried piranha.





In the southwestern United States and Mexico, the most spectacular seed necklaces are made from the bright red seeds of two native shrubs called mescal bean (*Sophora secundiflora*) and coral bean (*Erythrina flabelliformis*). The mescal bean plant is a very attractive evergreen shrub with drooping clusters of violet-blue wisteria-like flowers. Mescal beans are especially interesting because they were used by a number of Indian tribes in a vision-seeking "Red Bean Dance," centered around the ingestion of the plant's potent beans. In fact, at least a dozen Indian tribes in New Mexico, Texas, and northern Mexico practiced the hallucinogenic Red Bean Dance. The vivid red mescal beans have been found at Indian sites dating back to 1,500 BC. Since mescal beans contain the highly toxic quinozidine alkaloid cytisine, and their ingestion often resulted in overdose and death, they were later abandoned for a safer, more spectacular hallucinogen — the peyote cactus (*Lophophora williamsii*). Today the beans still are used as a ceremonial necklace worn by the leader of the peyote ceremony, called the "roadman."

The native coral tree of southern Arizona and New Mexico is one of the most beautiful flowering shrubs in the United States. Like other species of *Erythrina*, the large red blossoms are followed by woody legume pods containing shiny red seeds. There are more than 100 species of *Erythrina*, mostly found in Mexico, Central and South America, and Africa. In fact, the distribution of *Erythrina* species supports rather nicely the theory of continental drift, which holds that Africa and South America were once directly connected with each other and with Antarctica, India, and Australia in a great southern supercontinent called Gondwanaland. Most species are readily propagated by cuttings and are popular as "living fences" in tropical countries. Coral trees are also commonly grown as shade trees on coffee and cacao plantations of Central and South America, and are often called "madre arbol" and "madre de cacao" by local natives. Although coral beans are used in seed necklaces throughout tropical countries of the world, they are quite poisonous if eaten. Many species contain erythroidine and related alkaloids which cause paralysis and death by blocking acetylcholine receptor sites at neuromuscular synaptic junctions. This is essentially how curare, a gummy extract from the bark and stems of a South American vine *Chondodendron tomentosum*, works. Curare is highly prized by Amazonian Indians for blowgun darts.

Several other attractive seeds from the legume family (Fabaceae) are used for necklaces in the Caribbean, Mexico, and Central America. The most spectacular are the striking half-red, half-black



Compound leaf, berries, and shiny black seeds of soapberry (*Sapindus saponaria*). The hard, woody seeds, known as "black pearls," are commonly used in seed necklaces from tropical America.

seeds of the precatory bean plant, *Abrus precatorius*, and those of the very similar vine, *Rhynchosia precatoria*. Although the seeds of both species may be toxic if ingested, those of the precatory bean plant are particularly dangerous because they contain insidious proteins called lectins. Lectins can cause red blood cells to clump together (agglutinate) and may stimulate abnormal cell division in quiescent B- and T-lymphocytes. However, their hard seed coat makes it unlikely that one would suffer fatal poisoning from swallowing them; the seeds would only be greatly potent if thoroughly chewed or ground up. One fully masticated seed could be fatal to an adult human. In spite of their reputation as one of the world's most deadly seeds, precatory beans are certainly one of the most beautiful seeds on earth. They are sometimes called prayer beans or rosary beans and have been used for rosaries. Because of their remarkably uniform

Since the first records of Neolithic man in Europe approximately 5,000 years ago, amber has been used as a barter item, cherished not only for its beauty, but because it was thought to heal many types of illness and to protect against witchcraft, sorcery, and the evil eye. Many people believed that amber necklaces guarded against chills by absorbing body heat by day and retaining it at night. This Baltic amber from the collections of the Natural History Museum of Los Angeles County, containing an unidentified insect, is estimated at 30 million years of age.



Dick Meier



The fragrant, purplish-blue blossoms of mescal bean (*Sophora secundiflora*) resemble wisteria.



A ceremonial mescal bean necklace. To this day, the colorful necklace is worn by the leader of the peyote ceremony. Below it is a colorful strand made from mescal beans and shiny black seeds of Texas buckeye (*Ungnadia speciosa*).



weight of one-tenth of a gram, seeds of *Abrus precatorius* were used by goldsmiths of East Asia as standard weights for weighing gold and silver. In fact, the famous Koh-i-noor diamond of India, now one of the British crown jewels, was reportedly weighed using seeds of *Abrus precatorius*.

Another small leguminous tree of the Caribbean, called "jumbie bead" (*Adenanthera pavonina*) produces brilliant red, shiny seeds that are remarkably similar in general appearance to Sudafed<sup>TM</sup> tablets. Jumbie beads make striking red necklaces and apparently are innocuous compared to other poisonous red-seeded species. An individual seed also has a remarkably constant weight of about four grains (0.26 gram). In early times they were known as Circassian seeds and were used by goldsmiths throughout Asia as a standard measure for weighing gold, silver and diamonds.

Tropical forests of the Caribbean, Mexico, and Central America are rich in beautiful seeds, many of which are washed by torrential rains into the sea, where they drift to foreign shores. Sea beans (*Mucuna* and *Dioclea*) are favorite seeds for Indian necklaces, primarily because of their striking multi-layered appearance and amazing durability. In fact, they can be polished in a stone tumbler, as you would polish agate and quartz, or by using tin oxide and a buffing wheel. Polished sea bean pendants sometimes contain the embossed initials of the proud owner. Sea beans are also called "hamburger seeds" because of the unusual central layer (hilum) where they were connected inside the bean pod. The Spanish name for sea bean is "ojo de buey" because of its striking resemblance to the eye of a bull. Sea beans are produced by climbing woody vines (lianas) that twine through the tropical forest like a botanical boa constrictor. The seed pods are covered with microscopic velvety hairs (trichomes) that can be extremely irritating—especially if they get into the eyes. In the Caribbean and Central America, the hairs were stirred into honey or syrup as a remedy to expel intestinal parasites.

In San Jose, Costa Rica, sea beans are sold by street vendors along with another unusual drift seed called Mary's bean (*Merremia discoidesperma*). Unlike the true sea beans, the Mary's bean is produced by a climbing vine of the morning-glory family (Convolvulaceae). The vine is native to forests of Central America, and the seeds occasionally drift ashore on beaches of southern Florida. Several beliefs surround the Mary's bean in northern Europe. It was a special find to pious beachcombers: the seed had obviously survived the ocean and would extend its protection to anyone lucky enough to own one. A woman in labor was assured an easy delivery if she clenched a Mary's bean in her



hand. Seeds were handed down from mother to daughter as treasured keepsakes. It is known as crucifixion bean because of the cross etched on one side. The Mary's bean is also one of the most elusive of all drift seeds. After searching diligently on several Palomar College field trips to the Caribbean, I had given up when a Mary's bean turned up in my martini — a gift from my biology students (actually I suspected a prank because the bogus "olive" was much too buoyant).

Some sea beans resemble large wooden hearts and are called sea hearts (*Entada gigas*). They are produced in huge bean pods up to six feet long that hang from a tropical vine. The vines usually grow along freshwater streams, and the seeds, falling into these streams, are carried to the ocean. Some sea hearts cross the Atlantic Ocean from tropical Africa and then are carried to the Caribbean and the Gulf of Mexico, eventually drifting ashore on the beaches of southern Florida. Others continue their ocean journey to beaches of northern Europe. With their protective waterproof coat, they can survive years at sea, and often will still grow if planted in soil. To insure germination, the thick, woody seed coat must be scored with a hacksaw blade so the embryo inside can absorb water. In my experience, they grow upward very rapidly (up to an inch a day), but do poorly when I try to train them on a trellis or curtain rod. Sea hearts are highly prized by beachcombers and are unquestionably the ultimate unique gift for Valentine's Day.

Sea hearts have a long and colorful history in fact and fiction. It is said that the sea heart provided inspiration to Christopher Columbus and led him to set forth in search of lands to the west. In fact, the sea heart is called *fava de Colom*, or "Columbus bean," by Portuguese residents of the Azores in the North Atlantic. In Norway, a bitter tea was made from sea hearts to relieve pain during childbirth. In England, sea hearts were used as teething rings, and as good luck charms for sailors embarking on a long ocean voyage. Sea hearts and a similar rectangular seed (*Entada phaseoloides*) were commonly used in Norway and northern Europe for snuff boxes and lockets. The seeds were cut in half, the contents removed, and the woody seed coats hinged together. Their intrinsic beauty was enhanced with a fine finish of tung oil or lacquer.

Many other drift seeds originate on tropical beaches of the West Indies and follow the Gulf Stream to the North Atlantic. Hebrides Islanders off the coast of Scotland wore marble-like nickernut seeds as an amulet to ward off evil spirits. Known in the Hebrides as the white Indian nut, the seeds supposedly had other magical powers, including the ability to cure dysentery when the powdered seed embryo was taken with boiled milk.



The strikingly similar rosary beans of *Rhynchosia precatoria* (left) and *Abrus precatorius* (right). *Rhynchosia* seeds are smaller and the attachment scar (hilum) is in the red half.



An unusual sea purse (*Dioclea megacarpa*) rosary from El Salvador.



A sea heart necklace (*Entada gigas*) — the perfect gift for Valentine's Day.





An unusual seed necklace from Nepal. The *Martynia* pod (bottom) resembles the skull of a pit viper. It is flanked by two polished gray nickernuts (*Caesalpinia bonduc*).



Drilled gray nickernuts (*Caesalpinia bonduc*) for sale in the marketplace of Guayaquil, Ecuador. They are made into bracelets for good luck and to ward off the devil. The red and black seeds are from an Amazonian tree called "tento" (*Ormosia*), and are commonly used in seed necklaces and earrings.

Nickernuts grow wild on beaches of many Caribbean islands and are produced within unusual prickly pods on a scrambling or climbing shrub. Two species with attractive yellow or gray seeds (*Caesalpinia major* and *C. bonduc*) are commonly used for necklaces and bracelets, often being mixed with the distinctive red and black seeds of rosary bean and elongate seeds from the huge pods of royal poinciana (*Delonix regia*).

In Guayaquil, Ecuador, drilled nickernuts are sold by street vendors along with a variety of other seeds and herbs, including the striking red and black seeds of the necklace tree (*Ormosia monosperma*). The nickernuts are strung and worn as bracelets for good luck and to ward off the devil. In the Caribbean, nickernuts are used as marbles by native islanders and have been exported to Europe for buttons. In fact, nicker is an old English name for marble. The curious name "burning bean" comes from the fact that when the seed is rubbed vigorously on clothing it becomes quite hot. Touching a hot seed to the skin of an unsuspecting victim is a favorite game of children.

Weedy plants are occasionally used for seed necklaces in the tropics. The wild tamarind (*Leucaena leucocephala*) is a common shrub along roadsides throughout tropical regions of the new world. It is a prolific seed producer — with 12,000 seeds to a pound. The shiny brown seeds are softened in boiling water and strung on fishing line to make attractive necklaces and belts with intricate designs. The leaves and flattened seed pods make a high protein fodder for livestock, but horses, donkeys, and hogs lose hair if they consume the plant. The seeds and foliage of *Leucaena* contain large



amounts of the amino acid mimosine, which causes inhibition of hair growth and loss of hair in laboratory mice.

In Costa Rica, hundreds of tiny brown seeds from jimsonweed (*Datura stramonium*) are strung with pieces of brightly-colored felt to make an unusual and very attractive necklace. Although there are many species of shrubby and tree-like jimsonweeds, this particular species is a cosmopolitan annual weed and a prolific seed-producer. Hundreds of seeds are produced in spiny capsules, sometimes called "thorn-apples." In 1676, British Soldiers stationed in Jamestown, Virginia, became intoxicated by *D. stramonium* when it was inadvertently (or intentionally) included in their salads by the regimental cooks. The episode was widely publicized and the plant culprit became known as "Jamestown weed," and later as jimsonweed. Of all the wild plants utilized in one way or another by people, *D. stramonium* certainly has one of the most sinister historical backgrounds, particularly in medieval Europe. Through the centuries this innocent-appearing plant has been involved in witchcraft and demonology, in sly but cunning seductions, and in sexual orgies. Other species of *Datura* have been an important ceremonial plant in several Native American cultures and have provided some valuable clinical drugs.

One of the most remarkable legumes of the New World tropics is the guanacaste (*Enterolobium cyclocarpum*), a huge canopy tree of the tropical rain forest. This beautiful tree with fernlike twice-pinnate leaves is also naturalized in southern Baja California and the Hawaiian Islands. The word guanacaste, which is also the name of the Costa Rican province of Guanacaste, is of Nahuatl origin and signifies "ear tree." The peculiar coiled, leathery pods superficially resemble the shape of a human ear. The nutritious pods are used for stock feed and the bark and wood are used for tanning and lumber. One of the most interesting uses involves the hard, woody seeds that litter the ground beneath large trees. Guanacaste seeds have a distinctive brown "eye" and make some of the most striking seed jewelry in Central America, especially when they are enhanced with a fine finish of tung oil or lacquer. In Costa Rica the seeds are used in a variety of bracelets, necklaces, and earrings, often mixed with distinctive red and black rosary beans.

The seeds and hard, stony endocarps of several palms native to the luxuriant Napo River rain forest in Ecuador are used for necklaces. One of the most striking is the starnut palm (*Astrocaryum huicungo*), so named because the seed-bearing endocarps have etched, starlike designs around the three pores at the basal end. Starnut palms are unmistakable in the dense rain forest, with long,



#### TOP

A yellow nickernut necklace (*Caesalpinia major*). Two marblelike seeds are produced in a spiny pod on a climbing beach vine. The red and black seeds are rosary beans (*Abrus precatorius*) and are extremely toxic if ingested.

sharp spines up to five inches long. The bony, top-shaped endocarps are polished and made into necklaces by Indians living along the Napo River, a tributary of the Amazon. They are often strung with shiny gray seeds of Job's tears and the distinctive red and black seeds of the necklace tree (*Ormosia*). Some of the Amazonian necklaces are also adorned with brightly colored parrot feathers, claws, and teeth of jaguars; one even sported a dried piranha. Peruvian Indians hunt monkeys for food and use the monkey bones for necklaces. Hollow, slender bones are often strung with bright red seeds from a species of necklace tree (*Ormosia*) or from the tropical vine (*Rhynchosia*). Sometimes the entire monkey skull is displayed in the necklace. Peruvian Indians also string claws from the giant anteater or lesser anteater (tamandua) with metallic leg segments from a species of tropical beetle.

The white, dried endosperm of some palm seeds contains a substance called hemicellulose that becomes so hard and dense that it is used

#### BOTTOM PHOTOS

Wild tamarind (*Leucaena leucocephala*), a common tropical roadside shrub with clusters of papery seed pods, produces shiny brown seeds, which are strung into necklaces with elaborate designs.



RIGHT

The infamous jimsonweed (*Datura stramonium*) produces hundreds of tiny brown seeds in a spiny capsule. In Costa Rica the seeds are strung with pieces of brightly-colored felt to make a very attractive and unusual necklace such as the one below.



The famous Maharajah coconut pearl sitting in the shell of a coconut. This priceless botanical jewel is on display at Fairchild Tropical Garden in Coral Gables, Florida.



as "vegetable ivory" for buttons, chessmen, and scrimshaw. It can be carved and polished like ivory tusks, without endangering whales, elephants, and walrus. Like wood, vegetable ivory is essentially composed of thick-walled dead cells; however, unlike grainy hardwoods, it has a texture and hardness similar to ivory. In fact, vegetable ivory is remarkably dense, with a rating of roughly 2.5 on the Moh scale of mineral hardness. (Compare this rating with 2.7 for ivory, 3.5 for a copper penny, and 10 for diamond.) Several tropical palms are known to produce vegetable ivory, but one of the most important is *Phytelephas macrocarpa*, also known as the ivory-nut palm. The generic name *Phytelephas* is derived from the Greek words *phyton* (plant) and *elephas* (elephant). This beautiful palm with huge pinnate leaves grows wild along the Napo River. Four or more large seeds are produced in a spiny fruit the size of a grapefruit. The seeds are so hard that it requires a hacksaw to cut one in half. Called "taguas" by local Indians, the endosperm of immature seeds is pulpy and sweet — food for people and animals of the region.

Probably the most remarkable of all botanical jewels is that produced by the coconut palm

(*Cocos nucifera*): the legendary "coconut pearl." There is considerable disagreement among botanists as to whether coconut pearls actually exist or are figments of imagination. In fact, several botany textbooks flatly state that coconut pearls are a hoax because proof of their existence is totally unfounded. Some botanists believe that they are actually concretions from giant *Tridacna* clams. However, seeing is believing, and the famous Maharajah Coconut Pearl, on display at Fairchild Tropical Garden in Miami, was discovered on Celebes Island in the Java Sea and presented to Dr. David Fairchild in 1940.

According to a display at Fairchild Tropical Garden, coconut pearls come from "blind coconuts" — so called because the inner nut or endocarp does not have the three characteristic "eyes" (germination pores) of a typical coconut. Without a germination pore the embryonic growth within the hard-shelled nut is retarded, and this abnormal situation may in some unknown way be related to the formation of a stone.

The coconut pearl is certainly the rarest and most valuable of all "botanical gemstones." In fact, its exact chemical composition has remained an enigma because most researchers are reluctant to damage one during an assay. According to biochemist Abraham D. Krikorian (*Principes* Vol. 26, 1982), who has studied the writings of the distinguished 17th-century naturalist Georg Eberhard Rumphius, the "pearls" appear to be calcareous. Rumphius reported that coconut stones readily lose their luster when boiled in a weak acid solution of vinegar or lemon juice, suggesting that they may be slowly dissolving. From the limited available information so far, they do not appear to be the same chemical composition as vegetable ivory or the siliceous stones that form inside bamboo stems.

It is difficult to place a monetary value on a genuine coconut pearl, but the odds of finding one in a coconut are certainly less than one in a million. In his classic six-volume work entitled *Herbarium Amboinense* (1741-1750), Rumphius described and illustrated exquisite coconut pearls, often mounted in jeweled settings of gold and silver, owned by Malaysian dynasties.

Another source of very unusual and beautiful necklaces are the Polynesian Islands of Hawaii and Tahiti. Although the candlenut tree (*Aleurites moluccana*) is native to Asia, it has been spread by people throughout the tropical Pacific because its seeds are rich in oil. The valuable oil, expressed from seeds, is used as a light source and as a mild cathartic. In the Hawaiian Islands, the seeds are known as "kakui nuts" and are polished and made into shiny dark brown or black bracelets and necklaces. In fact, the hard, angular seeds take such a brilliant luster that they resemble gemstones rather than seeds. Candlenut seeds occasionally drift ashore on islands of the Caribbean, and are known



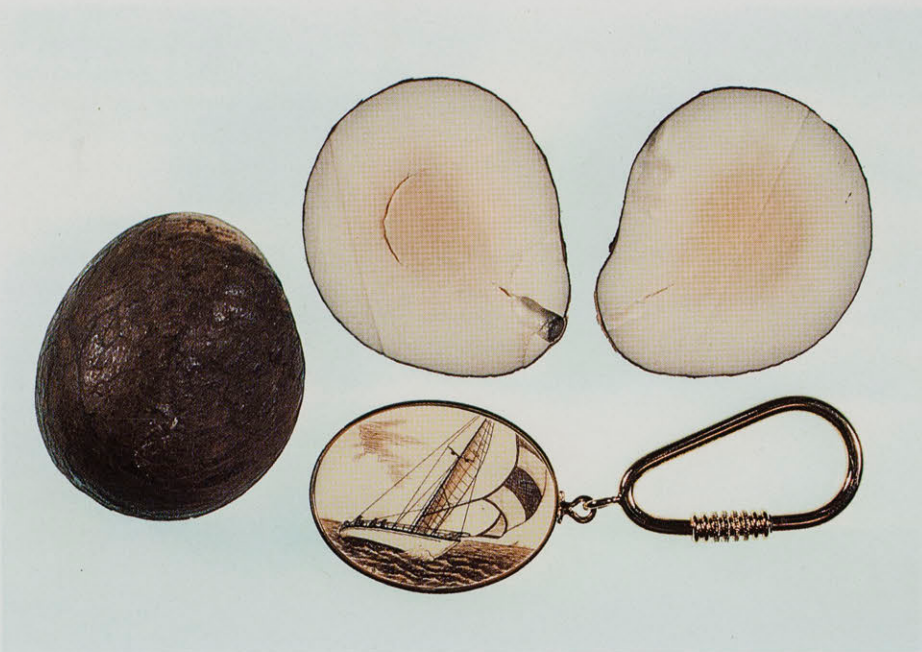
locally as "Jamaican walnuts" because of their superficial resemblance to an unshelled walnut. Tung oil, considered by some woodworkers to be the world's finest finish, is also produced from the seeds of a related tree (*Aleurites fordii*).

In Tahiti, the woody seed-bearing endocarps of "tianina" or lantern tree (*Hernandia nymphaeifolia*), are polished by native islanders and made into shiny brown necklaces. The seeds are so perfectly round that they resemble a string of marbles or machine-made beads. Each seed is produced in a remarkable fruit that resembles a fleshy red or white lantern. Another common Polynesian beach plant with unusual prop roots and large pineapple-shaped fruits is the screwpine or pandanus (*Pandanus tectorius*). The fruits are composed of hard, woody sections called "keys," each containing edible seeds. Pandanus keys are abundant on beaches of the South Pacific. They often become shiny red and are used to make colorful necklaces and leis.

There are many other plant structures cleverly crafted into unusual botanical jewelry. The West Indies mahogany (*Swietenia mahogani*) is a large tree of the Caribbean region with pods that split into woody sections releasing hundreds of winged seeds. In the Virgin Islands, sections of young mahogany pods are polished and made into earrings. Attractive earrings are also made from the polished shell (endocarp) surrounding coconut seeds. Another Caribbean tree (*Hura crepitans*) with an unmistakable trunk and limbs covered by sharp black thorns grows in forested areas and along roadsides. It is sometimes called "monkey pistol" because the unusual pumpkin-shaped seed capsule forcibly ejects seeds. The capsule literally explodes like a small grenade, only in this case the shrapnel consists of dozens of flat, circular seeds and many small crescent-shaped sections. Each section has the general shape of a porpoise or dolphin as it bounds through the water. The woody sections are made into earrings and clever pins. This tree is also called "sandbox tree" because the seed capsule was used to hold sand as an ink blotter — before the advent of felt or paper blotters and ballpoint pens.

Considering the marvelous diversity of plant species and human ingenuity, the possibilities for botanical jewelry are endless. As primary producers in the world ecosystem, plants provide us with food and oxygen. They also decorate our planet with verdant forests and colorful flowers, and adorn our bodies with unparalleled natural beauty.

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TOP  
Seeds of the ivory-nut palm (*Phytelephas macrocarpa*) and a simulated scrimshaw pendant.

BOTTOM  
A lovely vegetable ivory necklace made from polished seeds of the ivory-nut palm.



# The Words and Minds of Monkeys

by Robert Seyfarth and Dorothy Cheney

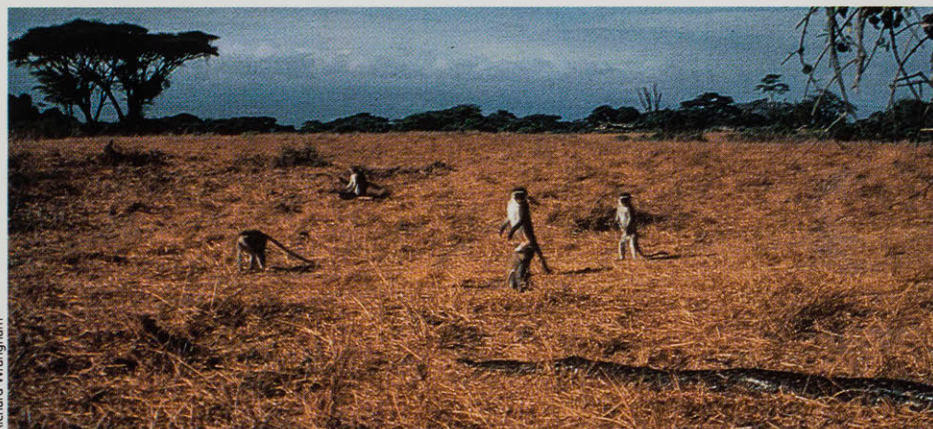
**I**N 1969, PSYCHOLOGISTS ALLEN AND Beatrix Gardner surprised the world with their announcement that a chimpanzee named Washoe had learned to use over 30 signs of American Sign Language to communicate about objects, make requests, and “just talk.” Washoe’s skills were striking because they suggested that animals other than ourselves might possess a kind of language, and that one day, through careful study, we might understand not only how another species communicates but also how it thinks, and how it sees the world.

For scientists studying chimpanzees and other primates in their natural habitat, however, Washoe’s use of signs was puzzling. Despite many years of careful observation, neither Jane Goodall, Dian Fossey, nor any other observer of apes in the

In 1967, Tom Struhsaker, then a Zoology graduate student at the University of California at Berkeley, presented the results of a year’s research on vervet monkeys — gray, cat-sized monkeys that live in groups of 10 to 20 individuals throughout the open savanna woodlands of East Africa. Struhsaker reported that vervets gave different-sounding alarm calls in response to at least three different predators: leopards, eagles, and snakes. Each alarm call elicited a different, apparently adaptive escape response from other monkeys nearby. For example, when the vervets were foraging on the ground, an alarm call given in response to a leopard (called a “leopard alarm”) caused others to run into trees, where the monkeys seemed safe from a leopard’s attack. Eagle alarms caused them to look up in the air or run into bushes, the only safe refuge from an eagle; and snake alarms caused animals to stand on their hind legs and look into the grass around them. Like Washoe, vervets certainly seemed to be using different signs to denote different objects, or different sorts of danger.

The notion that vervet alarm calls might function as words was, however, greeted skeptically by other scientists. Some suggested that, instead of denoting different predators, the vervets’ alarms might simply be general alerting signals — like a human crying “Hey!” — that caused animals to look all around them. Then, once monkeys had spotted the predator, their different escape responses occurred as a result of what they had seen and not what they had heard.

Alternatively, the monkeys’ calls might not denote different predators but instead simply be involuntary responses that reflected the relative intensity of fear aroused by leopards, eagles, and snakes. If this were true, then a loud, excited leopard alarm would evoke running into trees, a softer leopard alarm would evoke looking up, and a very



Vervet monkeys stand bipedally and give alarm calls at a python as it emerges from a bush.

wild had ever seen one of their subjects use a hand gesture or vocalization as if it were a word that stood for some feature of the environment. The mismatch between Washoe’s behavior and the behavior of apes in the wild could be explained only by accepting one of two rather different arguments.

On the one hand, Washoe might be like a circus bear who had learned to ride a bicycle: humans had taught her a skill that fell outside the range of normal chimpanzee behavior. If this were true, Washoe’s signs might tell us something about her *potential* for communication under artificial conditions, but they were largely irrelevant to research on the evolution of language. On the other hand, maybe scientists studying apes in the wild *had* missed some crucial feature of their subjects’ communication. If it turned out that free-ranging primates actually did use signs, either visual or vocal, to communicate about their environment, this would explain how Washoe — and later, many other apes — learned so many signs so quickly, and it undoubtedly would shed light on the problem of language evolution. Somewhat ironically, support for this view had recently been published.

#### BELOW RIGHT

Adult female Amin feeds next to her two-month-old son. When young infants are not being carried by their mothers, they often respond incorrectly to another animal’s alarm call.

#### OPPOSITE ►

Vervet mother and infant in captivity.











Adult females Marcos and Charing Cross look at another group just after Charing Cross has signaled its presence with a call. At left is Charing Cross's two-year-old daughter; seated between them is Marcos's eight-month-old daughter.

soft leopard alarm would cause animals to look in the grass around them. The analogy between vervet alarm calls and human words would be considerably weakened.

In another species, the California ground squirrel, just this sort of communication takes place. Ground squirrels give a "chatter-chat" alarm call in response to terrestrial predators like snakes and foxes and a "whistle" alarm call to hawks and eagles. The calls seem to be different words for different predators, but in fact they are not. California ground squirrels give whistle alarms in response to *any* predator that arrives suddenly. Most sudden attacks come from raptors, but occasionally the squirrels are surprised by a mammalian carnivore. When this happens, the mammalian carnivore elicits whistles. Similarly, chatter-chat alarms are given to predators that have been spotted at a distance. Typically, such predators are mammalian carnivores, but it is not unusual for the squirrels to give chatter-chat alarms to a distant hawk. What seem at first to be ground squirrel "words" denoting different predators are in fact ground squirrel calls that express different levels of fear.

In 1977, together with Professor Peter Marler at the Rockefeller University in New York, we designed experiments to test these different hypotheses. Our work was conducted in the same area where Struhsaker had carried out his original study: Amboseli National Park, in southern Kenya, at the foot of Mt. Kilimanjaro.

We began by learning to recognize monkeys individually and following them throughout their daily routine of foraging, feeding, resting, and social behavior. Soon we had accumulated tape recordings of the alarm calls given by vervets when they encountered leopards, martial eagles (the monkeys' main avian predator), or pythons. We

then carried out experiments in which calls were played to monkeys through a concealed loudspeaker and the animals' responses were filmed. When we examined our results we found that call playbacks duplicated the responses that occurred under natural conditions, when a predator was actually present. Playback of leopard alarms caused animals to run into trees, playback of eagle alarms caused them to look up into the air or run into bushes, and playback of snake alarms caused them to stand on their hind legs and peer into the grass around them.

Our experiments also showed that alarm calls did not simply reflect the caller's degree of fear or excitement: when we altered our tapes so that calls were made longer or shorter, louder or softer (two variations that might approximate changes in a caller's level of excitement), this had no effect on our results. And because we presented alarm calls when there were no real predators around, we could rule out the hypothesis that the monkeys' different responses depended on what they had seen rather than on what they had heard. In sum, each type of alarm call, presented on its own, elicited the same response as an actual predator. We concluded that vervet alarm calls, like the hand signals of captive apes, were signs that denoted features of the environment.

But do such results really elevate vervet vocalizations to the status of human words? Should we conclude that vervet monkeys responding to a vocalization actually *think* the way we do when we decode each others' remarks? How, after all, do the minds of animals work? Do they think? Are they aware of their own knowledge? In the pages that follow we discuss some of the ways in which philosophers, psychologists, anthropologists, and biologists are currently grappling with the problems posed by communication, thinking, and the minds of other animals.

## COMMUNICATION AND THE MIND

What goes on in a vervet monkey's mind when he gives a leopard alarm call, a grunt, or any of the other vocalizations in his repertoire? The simplest explanation is that there is nothing "mental" at all about monkey vocalizations: they're just relatively inflexible responses to particular stimuli, like a cry of pain when one inadvertently touches a hot stove. Alternatively, a monkey might give an alarm call, for example, only after he has studied the situation carefully and taken into account a number of different factors. Is the predator hunting? Are there other monkeys nearby? Are these animals kin, mates, or other close companions? Finally, calling might even be influenced by the states of mind that the signaler attributes to others. Conceivably, before giving an alarm call a monkey might ask himself, "Have other



group members already seen the leopard? Have they responded appropriately? Wait a minute: do I *want* others to think that I've seen a leopard?"

The distinction between communication of this sort and simpler, more reflexive acts that can nevertheless convey information has been discussed by many different philosophers, most recently Daniel Dennett of Tufts University. Dennett begins by assuming, for purposes of analysis, that vervet monkeys are "intentional" creatures, capable of mental states like believing, thinking, or wanting. The question then becomes, what kind of beliefs, thoughts, or desires? Here Dennett offers a number of different "levels of intentionality," each of which constitutes an hypothesis that can then be tested. Ideally, observations or experiments will allow us to eliminate all but one explanation, leaving us with a more precise understanding of how the vervet mind works.

To begin with, Dennett argues, we must entertain the possibility that vervets are *zero-order intentional systems*, with no beliefs or desires at all. A zero-order explanation holds that vervet monkeys give alarm calls simply because they are frightened. Vervets, moreover, experience a number of different kinds of fear, each associated with a different kind of predator. Each type of fear elicits a characteristic alarm call and a characteristic escape response.

Alternatively, vervets might be *first-order intentional systems*, with beliefs and desires but no beliefs *about* beliefs. At this level, vervet monkeys give leopard alarm calls, for example, because they believe that there is a leopard nearby or because they want others to run into trees. The caller does not need to have any conception of his audience's state of mind, nor need he recognize the distinction between his own and another animal's beliefs.

It is also possible that vervets are *second-, third-, or even higher-order intentional systems*, with some conception about both their own and other individuals' states of mind. A vervet monkey capable of second-order intentionality gives a leopard alarm call because he wants others to believe that there is a leopard nearby. At higher and increasingly baroque levels, both the signaler's and the audience's states of mind come into play. At the third level of intentionality, for example, a vervet gives an alarm call because he wants others to believe that he wants them to run into trees.

Humans are intentional systems almost to a fault. Our legal systems revolve around Byzantine efforts to establish intent, and our elections reveal with depressing consistency that politicians worry more about what others think (and what others think they think) than about the actual course of events. All the same, it is unlikely that even humans



Marc Hauser

regularly ascend (or stoop) to levels beyond third- or fourth-order intentionality in their daily lives. Whether *animals* are capable of second- or even first-order intentionality, however, is a hotly debated issue.

In Dennett's scheme, zero-order intentionality attributes no mentality at all to individuals. For many animal species, this is perfectly plausible. Male robins attack a territorial rival when they see his red breast, but they will also attack a clump of red feathers. The robins' behavior is easily explained by a simple link between stimulus and response; no mentality, or levels of complexity above zero-order intentionality, is required.

Vervet monkeys, however, are more complicated than this because they can "choose" to communicate or not depending on the presence (and identity) of their audience. Early in our research, for instance, we noticed that vervets never gave alarm calls when they were alone. In the most dramatic example, graduate student Phyllis Lee once found adult male Rosebery feeding alone in two small acacia trees located on a small island in the middle of a swamp. The rest of Rosebery's group was about half a kilometer away. Apparently, Rosebery had not noticed that a leopard had stalked him into the swamp until it suddenly leapt into his tree. For almost an hour the leopard pursued him, but Rosebery was lighter and far more nimble than the leopard. Eventually, he was able to jump out of the tree and make his escape through the swamp. What most struck Phyllis was the utter silence of the chase. In marked contrast to a leopard attack on a group of monkeys, when the air is filled with loud alarm calling by many individuals, it had all occurred without a sound.

Members of adult female Carlyle's matriline gather around Carlyle's newborn infant.





Members of groups A and B threaten and chase each other during an aggressive intergroup encounter. Vervets are territorial and defend their home range against incursion by other groups.

Struck by this anecdote, we carried out experiments on four groups of captive vervet monkeys that live on the grounds of the Veterans Administration Hospital in Sepulveda, California. Here each group's cage consists of an indoor and an outdoor enclosure connected by a chute that allows some animals to be temporarily separated from the rest of the group. In our tests we locked most of the group indoors, isolating an adult female in the outdoor enclosure with either her offspring or an unrelated juvenile of the same age and sex. The two animals were then approached by the captive monkey's version of a predator, a veterinarian wearing a surgical gown and mask and carrying a net. Upon seeing this predator, all adult females gave alarm calls. However, females gave many more alarms when they were with their own offspring than when they were with unrelated juveniles.

We can therefore reject the idea that vervet monkeys are zero-order intentional systems, capable only of involuntary cries. Instead the monkeys' calls involve at least first-order intentionality: apparently, vervets recognize the association between a particular sound and a specific escape behavior and make use of this knowledge to alter the behavior of others. Further evidence, however, suggests that monkeys may *not* be capable of second-order intentionality: that is, of communicating in order to affect what another individual knows.

Like children who must learn the meaning of words, infant vervet monkeys need time and practice before they learn how to use their different alarm calls. In their first year of life, infants often make mistakes and give alarm calls to species like warthogs or pigeons, which pose no danger to them. Although the infants are often mistaken, adults nonetheless respond when they hear an infant's alarm. If, for example, an infant gives an eagle

alarm to a stork, adults will look up but then quickly go back to what they were doing. By contrast, if an infant gives an eagle alarm to a martial eagle, adults will look up and then give alarm calls themselves.

When we first observed this behavior it seemed to be instructive, since it reinforced the infants' correct alarms. And, like many forms of human teaching, adult reinforcement seemed to be an example of second-order intentionality: adults behaved as if they were aware of the infants' state of mind, and were communicating in order to correct it. Looking closer, however, we found that adults were just as likely to give "second alarms" after a correct alarm by another adult as they were after a correct alarm by an infant. Even though infants made many more errors than adults, adults made no special effort to inform the infants when they were correct. We would expect such special efforts if adults were truly capable of second-order intentionality and when communicating took account of other individuals' states of mind.

Similar results emerged when we carried out experiments on captive groups of rhesus and Japanese macaques, terrestrial Asian monkeys whose social organization and behavior is very similar to the vervets'. Like vervet monkeys, both macaque species give alarm calls when they spot technicians with nets. They also give a "coo" vocalization when they're fed preferred food like fruit. Our experiment tested whether mothers would give more food or alarm calls when their offspring were unaware of the presence of food or danger than when they knew that food and danger were present.

Tests were conducted at the California Primate Research Center in Davis, California. There, each monkey group's enclosure is divided into two outdoor arenas connected by a long corridor. By manipulating the sliding doors along this corridor, we could temporarily separate one or more animals from the rest of the group, and this, in turn, allowed us to provide one individual with information that only she possessed. We then tested whether or not this informant ever selectively altered her behavior depending upon whether or not her audience was ignorant or knowledgeable.

We began each trial by separating a mother and her juvenile offspring from the rest of the group and placing them in the corridor. In the "knowledgeable" condition, mother and offspring were seated next to each other. Each could see the other and both could see the empty arena. In one set of trials, the animals then watched a human place a highly preferred food (apple slices) in a food bin in the empty arena. In another set of trials, the animals saw a "predator" (once again, a menacing



technician) who brandished a net and then hid himself behind a partition next to the arena. After each of these exposures, the offspring, but not the mother, was released into the empty arena.

In the "ignorant" condition, mother and offspring were also placed in the corridor, but the offspring was now seated to one side of the mother and separated from her by a steel partition. Now, only the mother could see the food or the predator. After the food had been placed in the bin or the predator had hidden himself, the offspring, but not the mother, was once again released into the arena.

If monkeys are sensitive to the mental states of others — that is, if they are capable of second-order intentionality and take their audience's knowledge into account when giving food or alarm calls — mothers should have uttered more calls (or in some other way altered their behavior) when their offspring were ignorant than when they were already informed. On the other hand, if informants are unaffected by their audience's mental states, the mothers' behavior should have been similar regardless of whether or not their offspring had also seen the food or danger. In fact, the mothers' behavior showed no difference under these two quite different circumstances.

The goal of our research is to clarify how the minds of monkeys work. We do this by observing how monkeys communicate under natural or artificial conditions and then asking "What must their knowledge of the world be like in order to account for what they do?" For the moment, we can rule out the simplest explanations of communication that posit no mentality at all — for example, monkeys give alarm calls simply because they are excited — since it is clear that monkeys use vocalizations selectively and can choose to communicate depending on their audience or its behavior. Despite their sensitivity to an audience, however, we have as yet no evidence that monkeys attribute mental states to others or recognize that these mental states can affect behavior. We can describe the mental state that underlies a vervet's alarm call by saying, for example, vervet mothers give eagle alarms because they want their offspring to run into bushes. We cannot — as yet — make the further claim that vervet mothers want their offspring to know that there is an eagle (or bird, or whatever) nearby. The difference is subtle but has enormous consequences for the speed and precision of learning, and for the transfer of knowledge from one generation to the next.

**MEANING AND THE EXTERNAL WORLD**  
But what, precisely, do the calls of monkeys denote? Thus far we have been describing vervet communication in terms of the mental states of signaler and



The martial eagle is the largest of the African eagles and preys on birds, small mammals, and monkeys.

G. Anzenberger



The leopard is one of the primary predators of vervets in Amboseli.

G. Anzenberger



Pythons hunt vervets by concealing themselves in thick grass or bushes, then seizing and constricting their victims. Like leopards, they regularly kill vervets in Amboseli.

Dorothy Cheney





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Washoe using American Sign Language to name objects; in this case, HAT for a knit cap.

recipient. Another, complementary approach examines communication in terms of the relationship between signs and the things for which they stand. In human language, for example, there are at least two ways to examine a mother's remark to her daughter, "Don't forget your jacket, dear." One focuses on the mother's attitude toward her daughter — does she know it's cold? has she forgotten her jacket before? — while another examines the relation between the word "jacket" and some object in the world. Does the mother have a specific jacket in mind? Would a heavy sweater be sufficient? What, precisely, does she mean by 'jacket'?

Similarly, if a vervet monkey mother gives an eagle alarm because she wants her offspring to run into bushes, what features of the world cause her to do this? And how do they differ from the features of the world that cause her to give a *different* sort of alarm, or no vocalization at all? So far we have been describing the vocalizations of vervets and the coos and barks of macaques as if each referred to a quite specific set of objects and events. Is this really the case? Can we define monkey words with the same precision that we define our own? The problem turns out to be trickier than it looks — not only in the case of monkeys, but also in the case of ourselves.

"If a lion could talk," the philosopher Wittgenstein said, "we would not understand him." For Wittgenstein, words are inextricably linked with the customs, concepts, and needs of the society from which they come. Without understanding a society, therefore, we cannot hope to define its words. The same holds true for vervets.

In Amboseli, vervets give their "leopard

alarm" in response to leopards, who hunt vervets, but not in response to lions, cheetah, or hyenas, who do not. For vervets, apparently, the meaning of "leopard alarm" is flexible and depends on the behavior of predators in the immediate area. Hence "leopard alarm" could mean "big spotted cat that isn't a cheetah," or "big spotted cat with the shorter legs," or however you want to describe it. In other areas of Africa, where cheetahs *do* hunt vervets, "leopard alarm" could mean "leopard *or* cheetah."

This point is nicely illustrated by the behavior of vervet monkeys in Cameroon, West Africa. There vervets on the savannah are sometimes attacked by feral dogs. When they see a dog they respond much as Amboseli vervets respond to a leopard; they give loud alarm calls that sound like the East African vervets' leopard alarm and run into trees. Elsewhere in Cameroon, however, vervets live in forests where they are hunted by armed humans who track them down with the aid of dogs. In these circumstances, where loud alarm calls and conspicuous flight into trees would only increase the monkeys' likelihood of being shot, the vervets' alarm calls to dogs are short, quiet, and cause others to flee silently into dense bush where humans cannot follow. For Cameroonian vervets in the savannah, then, dogs are included within the term "leopard alarm," creating a call whose meaning appears to be "terrestrial predators from which you can escape by running into trees." As long as new predators fall within this category the same alarm call will presumably be used. For vervets in the forest, however, referring to dogs with a leopard alarm call would be dangerously inaccurate; they therefore use another call.

The data from Cameroon suggest that leopard alarms in Amboseli denote a particular hunting strategy ("It's that thing that chases and grabs us on the ground!"). Once again, however, the explanation is not this simple, because vervets in Amboseli have a separate, acoustically distinct alarm call for what Tom Struhsaker originally called "minor mammalian predators": animals like lions, cheetahs, hyenas, and jackals that could pose a danger but, as far as we can tell, rarely hunt vervets. When the monkeys see one of these species they give minor mammalian predator alarms, become vigilant, and may move toward trees.

Two acoustically distinct alarm calls, then, are given in response to predators that have the same hunting strategy. Leopards differ from lions, cheetahs, jackals, and hyenas only in terms of the magnitude of danger involved. If one of these species began hunting vervets regularly, we imagine that the vervets would move it from membership in their "minor mammalian predator" category to membership in the "leopard" category.



Function, within a particular ecological context, thus determines the precision of word meanings and the specificity of external referents. The meaning of a call cannot be defined in absolute, context-free terms, as in "leopard alarm" denotes the African leopard, *Panthera pardus*." Instead, each call is best defined relative to the meaning of somewhat similar calls in slightly different contexts. "Leopard alarm" therefore denotes a predator or class of predators that is sufficiently different from those denoted by "minor mammalian predator alarm," "eagle alarm," or "snake alarm" to warrant a different vocalization. The criteria that determine whether two, three, or more alarm calls will evolve — and hence the criteria that determine each call's specificity — seem to be the predator's hunting strategy, the likelihood that it will attack, and the monkey's mode of escape. If two predators are similar according to these criteria, they will elicit the same alarm call. If they are different, they will not.

To some, this position may seem too much like a strategic retreat: after claiming that the vocalizations of vervet monkeys can refer to objects and events in the environment, we're in fact unable to state precisely *what* such calls denote. There are, however, good reasons for such imprecision, reasons that become even more apparent when we consider an intriguingly parallel case, the earliest speech of human infants.

From their first day of life, babies emit an extraordinary variety of grunts, babbles, and goos. Despite an understandable tendency for excited parents to interpret "nuklgfsst" as "nuclear physics," most psychologists agree that in its earliest stage babbling has no real meaning for the infant. In contrast to vervets, who can call or not depending on the circumstances, the infant's sounds are given at no particular time, and babies themselves give no indication that their noises are related in any way to specific objects or behavior.

During the next few months, however, life becomes more complicated. Infants can alter the timing of their vocalizations (babbling, for example, is more likely after an adult has spoken), and they begin to accompany their sounds with gestures, like looking and pointing, that direct the parent's attention toward a particular object. Still later, nonsense sounds are replaced by more precisely articulated noises, like "Dadoo" when pointing to another person, or "kitty" when both parent and child have been looking at a cat. Moreover, the child begins to use her vocalizations only in particular social circumstances. She says "bye," for example, only when someone is leaving, and much less readily to strangers than to grandmothers. Such observations suggest that the child is using words that have a specific meaning to her.

Even so, it is difficult to state precisely *what* the child means at this one-word stage of development. There is, moreover, a further complicating factor. Children at the one-word or two-word stage may know much more about their system of communication than is revealed in their own speech. It is possible, for example, that a child's one-word utterances are not single words but rudimentary attempts at a sentence. As a friend of ours fed her infant daughter one evening, the child repeatedly refused to eat and gestured instead toward the refrigerator behind her, loudly saying "Zert!" Being a psycholinguist, our friend's immediate reaction was not mild irritation but curiosity as to whether this was a one-word statement ("Dessert!") or a rudimentary sentence expressing the child's attitude toward a particular item or idea ("I want to eat dessert!" or "Give me dessert now!"). To test between these two hypotheses, she repeated the word "dessert" in a friendly, conversational tone. Understandably, this conversational gambit was immediately rejected by the outraged baby, as was holding up some dessert while saying the words, "Ah, yes, this indeed is a dessert." The only response deemed satisfactory from the baby's point of view was to provide a dessert and allow her to eat it. Apparently, "Zert!" was not a word but what linguists call a proposition. Its meaning included both reference to an object and a disposition to behave toward that object in a particular way.

Although children quickly go on to much greater things, for a few brief months communication by child and monkey is surprisingly similar. But while much of human communication is designed to influence the knowledge, beliefs and motives that underlie behavior, there is presently no evidence that monkeys ever communicate with the aim of influencing another animal's mental state. Like captive laboratory apes, monkeys in the wild can give or withhold vocalizations, depending on their audience, but they cannot communicate with an intent to modify the mental states of others because, apparently, they do not recognize that such mental states exist.

*Dr. Robert M. Seyfarth is Associate Professor of Psychology, and Dr. Dorothy Cheney is Associate Professor of Biology, at the University of Pennsylvania. They are the authors of How Monkeys See the World (University of Chicago Press, 1990). Their work focuses on the social behavior and vocal communication of monkeys and apes in these animals' natural habitat. Just as psychologists and anthropologists study language as a means of understanding how people think, their research uses vocal communication as a means of understanding the minds of other species.*



## Focus on the West

### The Glorious Adventure



In this illustration from the film's souvenir program, heroine Lady Beatrice Fair feels repulsion at the prospect of becoming a "favourite" of King Charles II.

J STUART BLACKTON WAS AN early motion picture pioneer and one of the founders of the Vitagraph film studio. In 1922, he produced *The Glorious Adventure*, an English historical melodrama with elaborate costumes and sets covering the time of Charles II and the Great Fire of London in 1666.

The film starred a member of the British nobility, Lady Diana Manners, as the heroine Lady Beatrice Fair. She is shown here in the clutches of Victor McLaglen in one of his first film roles. He plays Bulfinch, "a brutish denizen of London's Seventeenth Century Underworld."

*The Glorious Adventure's* greatest claim to fame, however, is that it was the first feature-length, all-color picture. Feature length meant five reels, or about an hour and ten minutes. To achieve color, two lenses were used, one with a red filter and the other with a green. The results were sometimes harsh or glaring, particularly in scenes where red costumes and sets predominated. The *New York Times* film reviewer observed these shortcomings, but still called the film "strikingly effective" and "significant of a new day," and correctly predicted that "the future will undoubtedly bring a perfection of color photography and an extension of its use that will greatly enrich the screen."

This photograph and souvenir program are just two of many items in the Seaver Center collections that are associated with the history and development of motion pictures. These collections contain a variety of related materials to assist the researcher, from photographs and personal papers to printed programs and yearbooks.

JOHN M. CAHOON  
Collections Manager  
Seaver Center for Western History Research

Focus on the West is a TERRA feature that presents the photographic highlights of the museum's Seaver Center for Western History Research. The Seaver Center is rich in photographs and other materials relating to the history of the American West.

OPPOSITE ►

Escaped prisoner Victor McLaglen is about to abduct Lady Diana Manners from her bedchamber while the Great Fire of London rages outside.





General file photo # 8660



## Acquisitions

*The tide had gone out and the level of the creek had dropped. The mud along the shore was fairly soft, but it was not sticking to the pelycosaur's feet. The beast was still hungry and was intent on finding more food. The only thing it had found all morning were some scraps of an edaphosaurid carcass. Unlike many mammalian carnivores of our time, pelycosaurs of long ago did not chew on bones. Bones were either swallowed or left behind. Turning slightly to the right and parallel to the shore, it moved determinedly, but in no great hurry, about two to four miles per hour.*

We have no idea if our pelycosaur, one of the primitive relatives of mammals, found its prey. We don't know that it was carnivorous or even a pelycosaur. We aren't even sure whether its hind feet or its forefeet left the longer prints. All we know for certain is that, about 280 million years ago, a large tetrapod left 25 consecutive footprints on a shoreline in New Mexico. These were excavated by Jerry P. MacDonald, who transported them to our museum. This new acquisition, a trail nearly twelve feet long, may be seen in the museum's main foyer, just around the corner from the Dinosaur Shop.

In 1987, Jerry MacDonald began exploring the rocks of the Robledo Mountains of New Mexico for fossil footprints. Our museum supported MacDonald's field work in return for one of the more spectacular trackways that could be displayed here in Los Angeles.

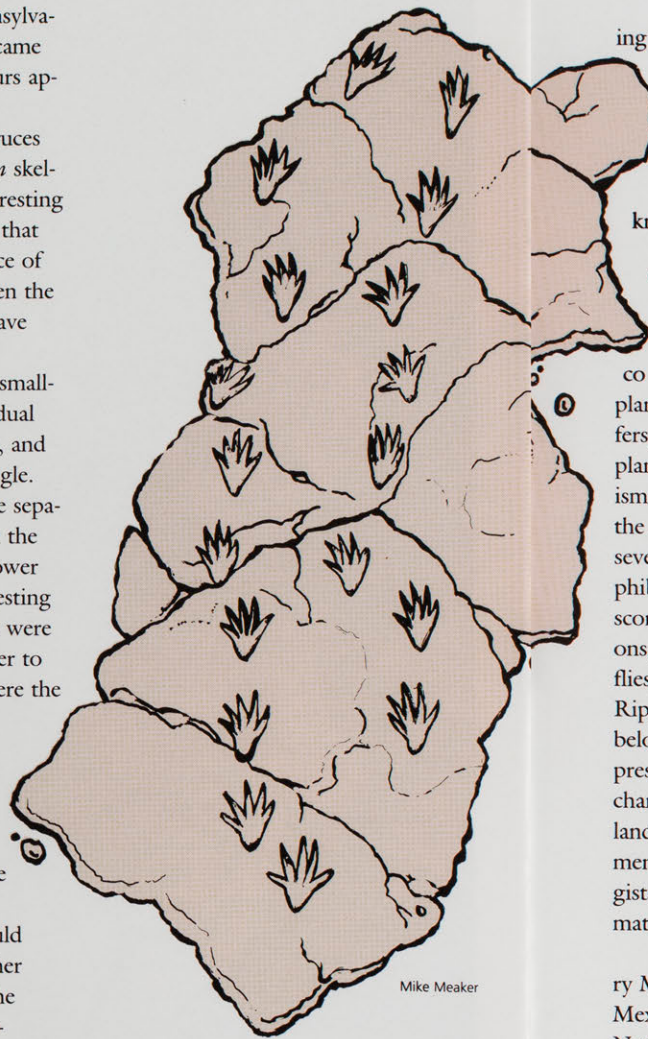
Our prints were found west of Las Cruces, New Mexico, in rocks of the Abo Formation. They date back to the early part of the Permian Period and were initially thought to be made by an unidentified species of pelycosaur. Pelycosaurs are frequently referred to as "fin-backed reptiles" because of the vertical "sails" on their backs which may have acted to help regulate body temperature. Our museum's example of the fin-backed pelycosaur *Dimetrodon*, from the Permian red beds of Texas, may be seen in the stairwell leading from the Main Foyer to the second floor. However, not all pelycosaurs had "sails."

Many people confuse pelycosaurs with dinosaurs, but these were two entirely different groups of reptiles. Pelycosaurs belonged to a group of reptiles that would give rise to mammals. Dinosaurs, pterosaurs, crocodiles and birds, on the other hand, represent a reptilian group that diverged from the mammal-like reptiles during the Pennsylvanian Period. Moreover, the last of the pelycosaurs,

common denizens of the Pennsylvanian and Permian periods, became extinct before the first dinosaurs appeared in Triassic times.

Contrasting the Las Cruces footprints with the *Dimetrodon* skeleton provides some other interesting information about the animal that left the tracks. There is no trace of the impression of a tail between the tracks, so our creature must have carried its tail well above the ground. Its prints are slightly smaller, suggesting a smaller individual than the *Dimetrodon* specimen, and are at a somewhat different angle. More importantly, the distance separating the "left feet trail" from the "right feet trail" is much narrower than that of *Dimetrodon*, suggesting that our creature had legs that were more upright and located closer to the center of the body than were the sideways-sprawling limbs of *Dimetrodon*.

The study of trace fossils, which constitute "fossilized behavior," is known as ichnology. Fossil footprints are examples of trace fossils or ichnofossils. Our example would qualify as a tracking trace, rather than a feeding trace. One of the more difficult aspects of study-



Mike Meaker



Mike Meaker

ing trace fossils is identification of the maker of the traces. It will take months, if not years, of research to determine whether or not our footprints were made by a new or previously known species of reptile.

Despite their apparent lack of "bony fossils," the rocks of the Abo Formation testify to the diversity of life in New Mexico 280 million years ago. Fossil plant remains include primitive conifers, seed ferns, leafless vascular plants, and algal mats. Other organisms that left trackways in rocks of the Abo Formation include at least seven other kinds of reptiles and amphibians, as well as trilobites, water scorpions, horseshoe crabs, scorpions, millipedes, centipedes, dragonflies, cockroaches, and silverfish. Ripple marks denote wave action below the shoreline; raindrop impressions and mud cracks record changing weather conditions on dry land. It is with the aid of such fragmentary evidence that paleontologists are able to interpret the climates and biotas of the past.

Additional assistance for Jerry MacDonald's field work in New Mexico was provided by the U.S. National Museum of Natural History (Washington, D.C.) and the Carnegie Museum of Natural History in Pittsburgh. The Los Angeles County Natural History Museum's pelycosaur trackway was obtained with funds donated by the Weingart Foundation.

J.D. STEWART  
Assistant Curator, Vertebrate Paleontology  
JOHN M. HARRIS  
Chief Curator, Earth Sciences

*The objects that museums acquire and preserve are in effect a permanent record of human endeavors and the natural world: at the heart of all of the Natural History Museum's activities are its collections. In Acquisitions, TERRA showcases a recent addition to the museum's holdings of more than 35 million specimens and artifacts.*



Don Meyer

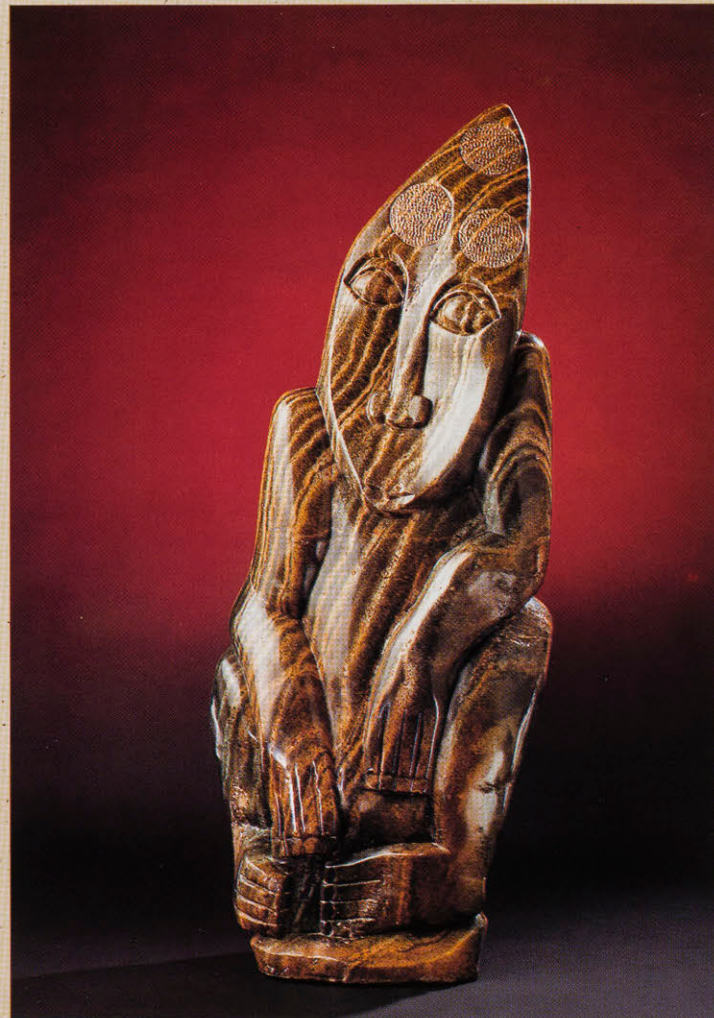
BELOW RIGHT

A restoration of the sail-backed, carnivorous pelycosaur *Dimetrodon*, painted in 1944 by Charles Knight. At right are the pelycosaur-like tracks recently acquired by the museum. The nine-foot long portion of the trackway, displayed in the museum's foyer, is from an isolated area west of Las Cruces, New Mexico. The remainder of the trackway continued beneath the base of a mountain and has not been excavated.



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ZIMBABWE  
SHONA SCULPTURE



(continued from page 3)

curator who is shepherding the hall to realization, traveled to Mesa Verde, Colorado and Zuni Pueblo, Arizona with staff from the Habitats division to take casts of masonry, rock faces, and architectural details for the hall. Cases must be "cured" to protect artifacts from wood and glue emissions before installation commences late this summer. The hall will open to the public in November or December of 1992. For information regarding naming opportunities that remain available within the hall, please contact Susan McCarthy at (213) 744-3307.

#### ■ BUSINESS ASSOCIATES

John Bedrosian, Senior Executive Vice President of National Medical Enterprises, addressed a group of business executives at the Natural History Museum in October 1991. Bedrosian, whose company supports the museum's Moveable Museum program, kicked off a 1991-1992 luncheon series designed to acquaint the corporate community with the museum's programs. More information on the luncheon schedule and speakers can be obtained from Allison Boyer at (213) 744-3307.

Isuzu Companies is the latest addition to the museum's Business Associates program. Business Associates receive special recognition for their support of our exhibitions and educational programs. This year, employees of those corporations are eligible for a 20 percent discount on new Active or Family memberships in the museum.

■ **FELLOWS** The Fellows sailed off in September on an oceanographic research vessel to trawl the coastal waters with Life Sciences Chief Curator Dr. Dan Cohen. Dan and his wife, Dr. Anne Cohen, also a marine biologist, led the crew in identifying creatures from deep and shallow waters. Later that month, the Fellows spent a nostalgic afternoon at the Hollywood Roosevelt Hotel, where they met film director Robert Wise and witnessed the advent of the museum's

American Costume Associates, a council that will support the History Division's costume and textile collections. Dr. Helen Jessup, who curated the Court Arts of Indonesia exhibition, and Professor Steve Lansing, who led the Fellows trip to Indonesia, made the exhibition opening in October a very special Fellows experience. In November, Peggy and Bob Sloves opened their attractive home to the Fellows, who dined with five experts on Mayan civilization. A week later, the Fellows joined Leakey Society and Explorers Club members at a private reception welcoming Dr. Meave Leakey and Dr. Alan Walker, whose research in Africa is uncovering the origins of humankind.

#### ■ SPONSORSHIP OPPORTUNITIES

The museum is actively seeking sponsors for two traveling exhibitions. Something's Afoot: Tracking America's Past Through Footwear is a whimsical and witty creation of the museum's History Division. Scheduled to open in September 1993, the exhibition draws from the museum's own collections as well as those of other institutions, and will travel to five cities over a period of three years. Whales, Dolphins and Porpoises is the working title of a new exhibition from the talented museum team that created our popular exhibition on sharks. A five-year multi-city tour is planned, beginning in spring 1995. Corporate and individual support of these exhibitions at \$50,000 or more will be recognized on the full international tour. Local sponsorship recognition in Los Angeles is possible for gifts from \$10,000. John Charnay at (213) 744-3307 has more information about sponsorship opportunities.

#### ■ TERRA VOLUME 29 INDEX

**AVAILABLE** The index for Volume 29 of TERRA (Fall 1990, Winter 1990/Spring 1991, and Summer 1991) is available upon request from the museum Publications Office, 900 Exposition Blvd., Los Angeles 90007.

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## **GREENLAND AND THE CANADIAN ARCTIC JULY 22 - 31, 1992**

Take in this remote land of ice from aboard the "Illiria." Explore the coast of Greenland and Canada's Baffin Island by Zodiac. You may view polar bear, arctic fox and hare, musk oxen, and at sea, seals and whales. We will enjoy the warm hospitality shown by the people who inhabit this frontier. **From \$3,495 plus air fare.**

## **ZIMBABWE JULY 24 - AUG. 8, 1992**

From the woodlands of the Zambezi River Valley, across the deep sands of the Kalahari Desert, to the rainforested lip of Victoria Falls, Zimbabwe is safari land in perfection. Here are the last remaining strongholds of the African elephant and black rhino. Optional extension to Botswana. **\$5,198 including air fare.**



GREENLAND AND THE CANADIAN ARCTIC

ERIC HOVANITZ

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This special voyage aboard the 70-passenger "Sea Lion" offers an in-depth exploration of the coastal wilderness of southeast Alaska and British Columbia, from Glacier Bay to Vancouver, including the magnificent, seldom visited Queen Charlotte Islands. **From \$3,690 plus air fare.**

## **THE TREASURES OF INDIA OCT. 11 - NOV. 9, 1992**

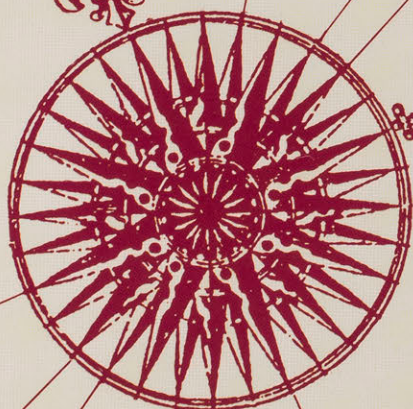
Exalt in the natural history and rich culture of this diverse country, where 5,000 years of continuous civilization have left a legacy of temples, monuments, and palaces. Visit Nagarhole and Kanha National Parks, where we may view tiger, elephant, leopard, and more than 200 bird species. **\$4,190 plus air fare.**

## **CHILE AND ARGENTINA NOV. 11 - 21, 1992**

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## **YUCATAN, LAND OF THE ANCIENT MAYA NOV. 30 - DEC. 13, 1992**

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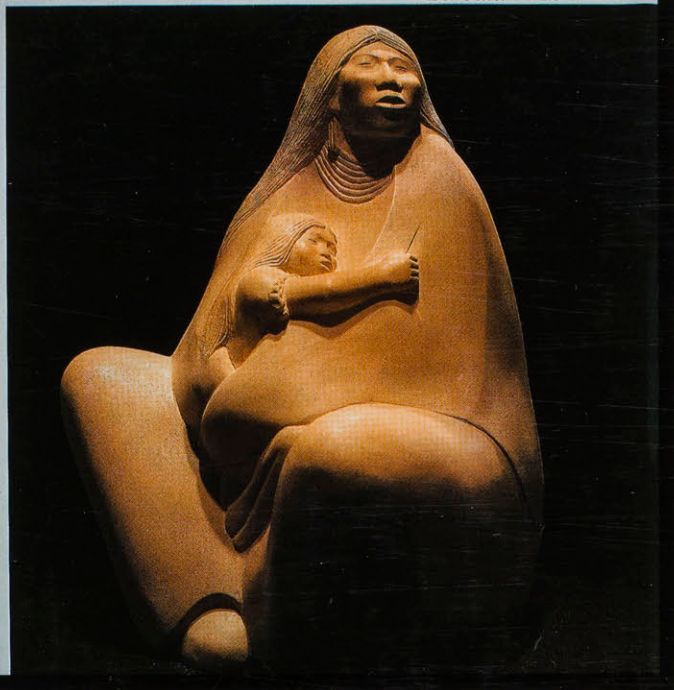
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